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Drainage and Reclamation

OF

Swamp and Overflowed Lands

By
Charles Kettleborough

Indiana
Bureau of Legislative Information
Bulletin No. 2

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INTRODUCTION.

This Bulletin, prepared by Charles Kettleborough of this Bureau, is designed to present in a brief, compact form the evolution, progress and present status of drainage and drainage legislation in Indiana; to enumerate and discuss the most significant results achieved in other states; to point out the inadequacy of our present system, the magnitude and economic importance of the question, the imperative need for state and national aid and supervision, and to suggest plans which it is believed will bring our drainage laws into harmony with those of the other states, render them less dilatory and more responsive, and afford the necessary instrumentality for the rapid and permanent reclamation of our non-arable swamp lands.

Considered purely as an economic question, as well as in its vital relation to the public health, this is a subject of paramount importance, involving a manifest public duty in the discharge of which, because of our imperfect and inadequate comprehension, we have been guilty of unconscious criminal neglect. There are 80,000,000 acres of unproductive swamp lands in the United States, a territory equal in extent to the combined area of Illinois, Indiana, Maine and Ohio, which is susceptible of profitable and permanent redemption.

In addition, there are 150,000,000 acres of arable lands which do not produce within 20% as much as they should because of insufficient drainage. These unprofitable, disease-breeding swamps, distributed over the entire national domain from the Atlantic to the Rockies and from the Lakes to the Gulf, constitute a national liability of several billions of dollars. To this incredible economic loss should be added an annual waste of $165,000,000 through the deaths, disability and loss of earning power due to malaria germs which flourish unchecked in these uncultivated areas.

Three states have approached this subject in a comprehensive, scientific and determined manner, and have already achieved results which have more than justified the predictions of the most sanguine advocates. Texas has added an average value of $25 to each acre of swamp lands within her spacious domains; Missouri has added $90,000,000 to the assessable value of her property within the brief space of 20 years; and it is confidently predicted that the redemption of the waste lands in Illinois will add $100,000,000 to the wealth of that state. During something more than a century, Indiana has reduced her swamp-land area by 2,500,000 acres and has added $68,000,000 to her assessable wealth. But even as late as 1910 the United States census reports disclosed that upwards of 1,000,000 acres were still unreclaimed, unproductive or only in a partial and uncertain state of cultivation. The annual loss to the state by reason of the existence of these waste and unproductive lands is admittedly $1,000,000. Surely the solution of this question by the extinction of this indefensible economic waste and the annexation of this extensive domain to our tax-paying assets should stimulate the imaginations and enlist the attention of constructive statesmen.

JOHN A. LAPP, Director.

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GENERAL ASPECTS OF THE QUESTION.

REVIVAL OF INTEREST IN DRAINAGE. The past ten years have witnessed an extraordinary revival of interest in the drainage and reclamation of our non-arable swamp lands, and it is safe to predict that no movement will be attended with more beneficial or far-reaching consequences. The most characteristic phenomenon in American history has been the great westward movement of the population, and the assiduous and untiring pursuit of the elusive frontier. Some fifteen years ago one of our most eminent contemporary annalists announced that the frontier had finally been extinguished. This prediction was manifestly premature, as extensive unpreëmpted areas of non-arable swamp lands still exist to inspire these hardy adventurers to further conquest. The latent impulses of a restless and nomadic population were successively stirred by the irresistible attraction of Kansas and Nebraska, Minnesota and the Dakotas, Manitoba and her sister provinces, the irrigable, arid regions of the far west, and the cactus and mesquite plains of Texas. The resurgent flow of population and the permanent interruption of these pageants of land hunters were effectually induced about ten years ago by the all but complete preëmption of these western lands, the nominal extinction of the frontier, and the increase in the price of arable lands conveniently and advantageously located, and has been succeeded by the wholesome and salutary contemplation of the value and possibilities of the neglected swamp lands of the Mississippi valley and the South.

UNRECLAIMED LANDS IN THE UNITED STATES. The magnitude of the task of draining and reclaiming the overflowed and swamp lands in the United States, and those too wet for agricultural purposes, is not generally appreciated. According to the most reliable and authentic estimates which have been made, there are at the present time upwards of 80,000,000 acres of these lands, capable of permanent and profitable redemption, about 60.000,000 acres of which are confined exclusively to the southern states. This desolate and submerged empire is equal in extent to the combined area of Illinois, Indiana, Maine and Ohio, and is almost three times as great as the superficial area of all New England. In addition to this, the Department of Agriculture has estimated that 150,000,000 acres of agricultural lands under cultivation are not producing within 20% as much as they should because of insufficient drainage.

ESTIMATED AREA OF UNRECLAIMED SWAMP AND OVERFLOWED LANDS IN THE UNITED STATES, RECLAIMABLE FOR AGRICULTURAL AND GRAZING PURPOSES.

State.	*Acres.*
Alabama	1,479,200
Arkansas	5,912,300
California	3,420,000
Connecticut	30,000
Delaware	127,200
Florida	19,800,000
Georgia	2,700,000
Illinois	925,000
Indiana	625,000
Iowa	930,000
Kansas	359,380
Kentucky	444,600
Louisiana	10,196,605
Maryland	192,000
Maine	156,520
Massachusetts	59,500
Michigan	2,947,439
Minnesota	5,832,308
Mississippi	5,760,200
Missouri	2,439,600

State.	*Acres.*
Nebraska	512,100
New Hampshire	12,700
New Jersey	326,400
New York	529,100
North Carolina	2,748,160
North Dakota	200,000
Ohio	155,047
Oklahoma	31,500
Oregon	254,000
Pennsylvania	50,000
Rhode Island	8,064
South Carolina	3,122,120
South Dakota	611,480
Tennessee	639,600
Texas	2,240,000
Vermont	23,900
Virginia	800,000
Washington	20,500
West Virginia	23,900
Wisconsin	2,360,000
Total	79,005,023

This gigantic extent of territory, capable of sustaining a population of fully 10,000,000 people and supplying homes of 40 acres each to 1,870,000 families, has been withdrawn from occupancy and cultivation because of the failure to adopt a systematic drainage plan which science and experience have demonstrated would be neither difficult nor costly. Engineers have estimated that the reclamation of the swamp lands of the South will result in greater benefit to the nation at large than the construction of the Panama Canal, since these lands are capable of sustaining a population of over 6,000,000 people.

Reasons for Promoting Drainage. The reasons for promoting drainage enterprises are to better the public roads and highways, to reclaim wet and overflowed lands or those subject to periodical submersion, to enhance the value of property, to improve the public health, and to promote the general welfare of the citizens.

FORMER OBJECTIONS TO DRAINAGE. Drainage has so abundantly proved itself to be both remunerative and beneficial that it is difficult to imagine that the question of its desirability should ever have been seriously discussed. Prior to 1860, however, a wide-spread and deep-seated hostility to any form of drainage prevailed, and this controversy, which had been waged with such incredible vigor, only subsided when the establishment of extensive and systematic experimental drains yielded unequivocal proof of their utility. And although drainage continued to receive increasing and well-merited attention and the attendant results were highly beneficial, it had not completely passed through the formative and experimental stage until 1880. Land was cheap and abundant and it was probably less expensive to appropriate unsettled, virgin territory than to redeem that subject to overflow. Moreover, the incontestable value of the chemical transformation wrought by drainage in rendering the soil friable and inducing a free and unobstructed circulation of air and moisture was ill understood by the early settlers. A few enterprising farmers in various parts of the country began draining their farms and were thereby enabled to plant their crops earlier and had actually increased the production two or three fold. This preliminary predatory warfare on water-logged soil gradually aroused public sentiment and recruits were slowly enlisted. The earliest results were so astonishing that even the most obdurate skeptics paid grudging and reluctant tribute to the achievements. Low lands which had been considered permanently irreclaimable and unproductive, and had lain idle from time immemorial, were drained and cultivated with complete success. Perennial swamps, formerly covered with water to a depth of two or three feet, yielded from fifty to one hundred bushels of corn per acre within a few years after the establishment of drains. The expense was so inconsiderable that the entire cost of drainage in many cases was fully repaid by the proceeds derived from the first crops grown.

Benefits of Drainage in Indiana. Fully 3,500,000 acres of land in this state, the most considerable portions of which are confined to the northwestern part, were originally swampy, non-arable, subject to periodical submergence, but capable of ultimate and permanent redemption. During the three-quarters of a century preceding 1880, the work of reclaiming these swamp lands had gone on so successfully and persistently that approximately 1,500,000 acres had been permanently reclaimed, leaving 2,000,000 wholly unredeemed or only in a partial and uncertain state of cultivation. The value of these wild and unsubdued lands as cow-pasture and sheep walks rarely exceeded four dollars per acre. All competent authorities agree that drainage increased their value to thirty dollars per acre, while the average annual production through lean and fruitful years, and considering their remoteness from fluctuating and uncertain markets, was fifteen dollars per acre. This calculation justifies the conclusion that the immediate value added to the total wealth of the state by the reclamation of these 1,500,000 acres was $45,000,000, while the combined value of the crops grown thereon during the thirty-three years which have elapsed since their redemption aggregates $22,500,000. Conversely, the annual loss which the state has successively sustained by the existence of these 2,000,000 barren and unproductive acres is $30,000,000. To further accentuate the magnitude and economic importance of this work, creditable statistics disclose that extensive drainage projects undertaken in the southwestern part of the state had redeemed 150,000 acres of the finest and most productive land in Knox county alone. Moreover, it was confidently asserted by capable and disinterested actuaries that the value of the 800,000 acres of waste lands situated in the Kankakee region could be increased $56,-

000,000 by promoting and securing their redemption, while the average annual production therefrom would aggregate $20,000,000.

Present Conditions in Indiana. Every year has witnessed fresh proofs of the value and recorded notable progress in drainage enterprises. But even as late as 1910, upwards of 1,000,000 acres were still unreclaimed, unimproved and unproductive. After allowing generously for the value of these waste lands for grazing purposes, the annual loss to the state by reason of their existence admittedly exceeds $7,000,000, a sum sufficiently large to pay the running expenses of this commonwealth for a year, or to completely extinguish the state debt twice over.

Results of Drainage in Texas. The swamp and overflowed lands of Texas cover about 5,000,000 acres, an area equal in extent to the states of New Jersey and Connecticut. These lands lie chiefly along the coastal plain and are perceptibly affected by the ebb and flow of the tide. The interior flood lands aggregate 3,000,000 acres. These undrained lands sell for from $10 to $20 an acre; when reclaimed they bring $50 or $60. The cost of drainage in no case exceeds ten or fifteen dollars. Lands which are under cultivation, but which are subject to an annual or semi-annual inundation, range in price from $5 to $25 per acre, depending on the frequency and severity of the floods to which they are subjected. The cost of constructing levees rarely if ever exceeds $25 per acre. The maximum cost in any case is $50 per acre. In the levee districts thus far completed the lands are valued at $75 per acre. The annual cost of maintenance and upkeep is inconsiderable.

Results of Drainage in Missouri. By the swamp land grant of 1850, approximately 3,346,000 acres of overflowed lands were patented to the state of Missouri, but the total unreclaimed area of that state aggregates 4,500,000 acres. In 1868, one body of land in that state, comprising 80,000 acres, sold for $664; the same tract of land is now worth

$8,000,000. At least three-fourths of the 2,572,800 acres comprising the seven southeastern counties of the state were originally unfit for human habitation, the timber was valueless, the public roads were impassable, and as late as 1890, some of this territory had no railroad. Towns and villages were scarce, and the metropolis of the region numbered only 2,178 inhabitants. The work of reclamation began in 1890, since which time 700,000 acres have been redeemed and rendered suitable for cultivation at a cost of from $3 to $6 per acre; the increase of population from 1890-1910 was 88.7%, while the increase in the rest of the state was only 20.7%. The assessed value of real estate increased 221%, while the increase in the rest of the state was only 76.5%. The railroad mileage increased over 200%, and the population of the towns from 250 to 1000%. The town which occupies the very center of this reclaimed area is said to be the richest town of its size in the United States. The value of the agricultural products shipped from this region in 1910 exceeded those shipped in 1890 two and one-third times. One million five hundred thousand acres in this region are still unreclaimed, but the work is being pushed rapidly forward. In one district, an expenditure of $121,000 netted a return of $1,442,500 in increased land values, an average of $58 per acre, and a return of $12 for every dollar expended. The improvements resulted in an increase of 75% in the yield of crops, which in two years time more than paid for the entire outlay. In another district, $66,405 spent for levees actually saved $654,000 worth of crops, and the construction of the levees added $1,280,625 to the value of the land, an average of $45 per acre, representing a return of $29 for every dollar expended, and for a period of 3 years every dollar spent for levees netted 460% on the investment. When drainage was instituted in the Little River Valley, timbered lands were selling for from $3 to $10 per acre; at the present time they are worth from $20 to $40 per acre, and similar lands at either side sell readily for from $75 to $125 per acre. In 1912, there were 197 drainage districts in the state whose combined area aggregated 3,546,186 acres, the total cost of which was $16,185,386.

It is estimated that if the swamp lands of Illinois were brought under cultivation they would add over $100,000,000 to the wealth of the state. In fact, the inexhaustible fertility of these lands and their value when reclaimed are frequently expressed in the maxim, "the wetter, the better."

DRAINAGE AND THE PUBLIC HEALTH. From the days when the adventurous pioneers first established settlements in the virgin territory and the primeval forests of the Mississippi valley, down to our own time, the public health has been exposed to constant peril from causes which the reclamation of the swamps and the cultivation of the land, and that alone, will effectually eradicate. In those early days the flood plains were so flat as to afford imperfect natural drainage, and the water which was deposited upon them by showers was left to stagnate or escape by evaporation. This rendered the atmosphere humid, misty and unwholesome, and, added to the decomposing vegetable matter, made the exhalations therefrom exceedingly deleterious. The drinking water was likewise seriously contaminated, and the inhabitants were visited by attacks of bilious and intermittent fevers, irregularities of the digestive organs, malaria, ague and headaches, which were not confined to the weak and aged, but attacked the young and robust. One of the most peculiar and prevalent maladies was a species of eruption, very painful and dangerous, accompanied by excessive irritation, and by a copious and poisonous suppuration, which accumulated and festered on the body of the patient. To add to the discomfort of the pioneers, the unreclaimed marshes bred noxious reptiles and insects. The bite or sting inflicted by these troublesome pests was highly poisonous and produced a painful inflammation. Cattle frequently died after eating the native grass or rushes which grew on the undrained reaches of the rivers.

The exhaustion of human vitality from malaria was appalling, and the mortuary records exhibit an astonishingly high percentage of deaths. The apothecaries and practitioners of 60 years ago were unable to successfully combat the inroads of this insidious enemy. Their sole remedy was quinine, which they administered to their patients in such generous quantities that the amount expended for that drug alone was almost equal to the amount paid for flour. It is now a demonstrable scientific fact that malaria is caused by the anopheles quadrimaculatus, a mosquito which flourishes in swampy regions and injects its poisoned virus by means of an exceedingly slender and attenuated proboscis. The female of the species lays many thousands of eggs in a season, and the rapidity of increase is incalculable. They thrive and multiply in hot weather, but if they are hermetically sealed up in a cake of ice all winter, they emerge in the spring as vigorous and destructive as ever. It was a near relative of this little insect which defeated the French so disastrously in their Panama undertaking under the renowned engineer, De Lesseps.

The tremendous havoc wrought by malaria, which is induced by this pernicious little pest, which flourishes only because there are swamps and flooded areas, was stated by Dr. Wm. A. Evans, former health commissioner of the city of Chicago, in an address before the National Drainage Congress at St. Louis, in April, 1913, when he asserted that the loss through malaria deaths amounts to $10,200,000 annually; the cost of disability and illness induced thereby, $92,000,000; the depreciation of real estate and loss in earning power of labor, due to malaria, $60,000,000; making an aggregate economic loss of $162,200,000 annually. In arriving at these conclusions, Dr. Evans frequently cut in half the generally accepted estimates.

The earliest experiments with drainage constituted unequivocal proof that when the land was drained bilious disorders, irregularities of the digestive organs, skin eruptions, ague, intermittent fever, malaria, inflammations, and other plagues and pestilences, would disappear or become less troublesome. This longed-for desideratum was not realized in a single generation in this state, however, and these preventable miasmatic diseases but gradually disappeared. Even as late as 1879 there was not a county in the state which did not have considerable areas of standing water. In Jackson county alone it was estimated that fully 100 square miles of land were subject to overflow. Systematic drainage had demonstrated itself to be of such incontestable value that physicians estimated that fully one-third of all autumnal sickness could be prevented by this means alone. In 1880, White River township in Johnson county had a tolerably thorough system of tile drainage. So it was decided to institute an investigation in that township to ascertain the influence of drainage on the public health. Medical practitioners were requested to examine their books for data. Two periods of five years each were selected, and they were requested to state the number of patients under their care, during these two periods, whose ailments were directly traceable to miasmatic causes. The results of the investigation were significant and disclosed that miasmatic diseases were as prevalent as all others combined, and that for the five years from 1860-1864, inclusive, the total number of persons afflicted with this malady was 1,480; and for the five years from 1876-1880, inclusive, 490. During the first period designated, drainage had not been generally instituted; during the latter period, a fairly complete system of drainage had been established and perfected. It was further estimated that miasmatic diseases had decreased at least 60% during the decade preceding 1881, and for the period from 1864-1881 it was estimated that there had been a decrease of 40% due to drainage alone These facts produced such a profound impression on the public mind that influential citizens undertook, unsuccessfully, to induce the state to undertake the drainage of certain localities under the direction of medical and engineering experts.

PUBLIC SENTIMENT AND DRAINAGE LEGISLATION. Since the burden of draining and reclaiming the swamp lands must rest ultimately on the people themselves, it is necessary to arouse public sentiment, to emphasize the economic value of drainage and to provide a convenient instrument by which public opinion may be effectually carried out. Much work has already been done along this line. Every state in the Union, with the possible exception of Alabama, has a drainage law; many states have adopted them recently; in most states they have been on the statute books for many years, and in at least one New England state, they date back to 1636. These laws, however, are incomplete, ineffective, and there is a bewildering lack of uniformity in their provisions. They should be standardized and simplified and co-operation among the several states should be vigorously promoted. The imperative need is for the adoption of a uniform drainage and levee law, not only clear enough to be understood but so clear that it cannot be misunderstood; this method of procedure will then become fixed in the public mind, and when its constitutionality is unequivocally established, it will enlist public confidence and adequate funds for drainage enterprises may be easily secured. Besides uniformity, simplicity and constitutionality, there must be a just and equitable distribution of expense and benefits. This irrepressible sentiment has led to the movement for the evolution of a broad and comprehensive plan to reclaim the swamp lands, the characteristic features of which are: Its freedom from dilatory restrictions; the legality of its provisions and requirements; its undoubted harmony with the constitutions of the several states.

THE MODEL DRAINAGE LAW. The First National Drainage Congress adopted a resolution requesting the Federal Government to enact laws to reclaim the swamp lands of the nation and insure their development, and for this purpose to create a National Commission to make surveys, estimate costs, and develop a comprehensive plan of national reclamation in connection with the several states so designed as to coördinate their mutual interest in a practical State and Federal System of consistent and progressive drainage, reclamation and development. The legislatures of the various states were likewise requested to enact drainage laws forthwith. To insure the passage of uniform, simplified and more effective drainage and levee laws for the various states, the executive officers of the National Drainage Congress called a meeting of all persons interested in this question to meet at Memphis, Tenn., on January 21, 1912. At this conference, the outlines of a model uniform drainage and levee law were formulated and a committee was appointed to complete the work. The bill as finally drafted was reported to the National Drainage Congress at its second meeting held in New Orleans in April, 1912, and approved. One state adopted this measure in a modified form at once and it has since been adopted by some six or eight others.

This model uniform law is based principally on the Missouri statute of 1909 as amended in 1911, the general provisions of the statute being retained and a few important amendments inserted. Probably no state in the Union has done more to develop consistent, scientific, comprehensive and praticable drainage laws than Missouri, and a study of the progress of drainage legislation in that state is inspiring. The results of more than a quarter of a century of intelligent and experimental investigation were expressed in the laws enacted in 1909 and 1911. They have been found adequate both in the organization and admintration of levee and drainage districts. Their general provisions have been used as models for the preparation of laws in other states, and the Department of Agriculture at Washington has enthusiastically recommended this system. The constitutionality of these laws has been universally upheld in the numerous opinions handed down by the Supreme Court of Missouri during the last few years, and whenever drainage districts have strictly adhered to the provisions of these statutes, their action has invariably been sustained. These laws were not without certain blemishes and imperfections, however, and the need existed to effectualize some of the less responsive provisions, to simplify their use and clarify their meaning by employing terse, expressive and perspicuous English. A critical investigation was accordingly undertaken, conducted by a Missouri engineer of recognized standing and national reputation, and the fruits of that admirable survey are now expressed in the Missouri law of 1913, and the model law which is its legitimate offspring.

The sections in this model law are arranged in the order in which the various steps must be taken to organize and administer the affairs of a drainage or levee district. These sections are divided into four groups: Organizational, Administrational, Definitional and Discretional. After enumerating the steps necessary to organize and administer the affairs of a drainage district, the terms, powers, duties and court procedures are given; those sections conferring additional or discretionary powers upon court, landowners or officers are placed last. The language employed is simple and direct, uncertain and ambiguous sentences are wanting, conflicting and contradictory sections are compressed and skillfully articulated, and not more than one separate and distinct subject is dealt with in a section.

Succinctly stated, the model drainage and levee law provides for the organization of drainage and levee associations, for sanitary or agricultural purposes, on petition of the owners of a majority of the lands affected, filed with the appropriate circuit court.

The administrative supervision of the district is entrusted to a Board of Five Supervisors, who are owners of real estate in the district, and who hold office for terms of five years, the term of one supervisor expiring annually, and who are elected by all of the landowners of the district.

The duties of this Board are:—to appoint an engineer to perfect a plan for reclamation; to levy a tax at a level rate of 25 cents per acre to defray all preliminary expenses; to supervise the construction of all work designed in the plan for reclamation and approved by the court; to levy a tax to defray all costs and to provide for its collection in annual installments; to employ an attorney; to issue bonds or other evidences of indebtedness; to appoint overseers to police the district; to levy a maintenance tax annually; and to provide if necessary or desirable for the progressive consolidation of contiguous districts.

The features of this law which should commend it to the serious and thoughtful consideration of the lawmakers of those states whose laws are ambiguous and unsatisfactory are the following: Its adequacy in the promotion of drainage enterprises; its simplicity and the ease with which the procedure in organization, administration and maintenance may be understood; its undoubted constitutionality; it is just and equitable, affording protection to the small holder against the rapacity of dishonest promoters; it equalizes the costs in proportion to the benefits derived; it is thoroughly democratic, in that the most important part of the work is intrusted to the persons directly interested and who will be taxed for construction, operation and maintenance, and where it continues to reside until the end of the district's corporate existence.

Comprehensive Drainage Systems. The process of improving and straightening natural streams and watercourses and constructing supplementary artificial channels is temporarily and locally successful. When districts are enlarged and extended by the incorporation of contiguous territory, the capacity of the existing drains is frequently inadequate, and the area subsequently added is inevitably drained at the expense of the original system. These unfortunate conditions grow progressively more acute. To guard against such disastrous contingencies, each district should be designed as a part of a complete and harmonious system, based upon existing topographic and hydrographic conditions. In this way, the development of independent drainage units will be rendered feasible, and the main drain and the tributaries will be so adjusted to each other that each succeeding increment of water will be adequately accommodated by a corresponding increase in the cross section of the main stream. The ultimate economic advantage of this procedure is apparent. It follows naturally, then, that all drainage enterprises of any magnitude should invariably be preceded by a thorough, systematic and scientific survey. The preliminary investigation to ascertain the feasibility of a proposed reclamation project will cost from 7½ to 15 cents per acre. The complete survey, including the preparation of maps, profiles and specifications, will not cost to exceed 25 or 30 cents per acre. The complete survey, instituted to ascertain the practicability and economy of a drainage project, should include accurate scientific data on the following subjects: The total drainage area; the maximum annual precipitation; the maximum quantity of water to be disposed of; the climatological conditions and the frequency and severity of floods; the elevations and depressions; the courses and capacity of streams; the location of buildings, roads, bridges, railroads, forest areas and arable and non-arable lands; the probable cost of the work, including clearing, installation of machinery, excavation, deterioration and profit; the comparative cost of large and small drains; the dimensions of proposed drains, including the probable stability of the banks, and allowing generously for the inevitable sloughing, caving and accumulation of talus, with ample berms, and a contemplated clean-out after a lapse of 2 or 3 years when the disturbed earth has become sufficiently compacted. The information thus accumulated will be a permanent and invaluable asset to the community and can be used in perfecting plans of reclamation, estimating costs, assessing benefits, providing for a harmonious and progressive development of complete and integrated systems of drainage and in the construction of roads, bridges, telephone, telegraph and power lines.

This method has already been adopted by five states of the Union, but only four have used it extensively or successfully.

Missouri. The most colossal drainage project ever undertaken in the United States is in the Little River Drainage District in southeastern Missouri. This district comprises an approximate area of 560,000 acres, and is about equal in size to the state of Rhode Island. It is 90 miles long and its average width is 17 miles. The watershed draining into this district has an area of 1,136 square miles. The topographic expert who prepared the plans is an acknowledged authority in that exacting science. When the plans were completed, they were submitted to several of the most eminent engineers in the United States for inspection and approval. When the drainage system is completed, there will be 700 miles of ditches and levees. The benefits assessed and confirmed by the court amount to $13,500,000, and the total cost will be about $4,500,000.

Texas. The existence of extensive areas of unreclaimed lands in Texas has called for centralized and heroic action. Accordingly, a State Levee and Drainage Commission was created in 1909, consisting of the Governor, the Attorney General and the Commissioner of the General Land Office. Acting on authority conferred by the statute a capable and experienced topographer, connected with the United States Geological Survey, was selected as the first State Levee and Drainage Commissioner. Surveys were immediately instituted through a formal coöperative contract with the United States Geological Survey, by the terms of which the state designated the areas to be mapped, the Federal bureau conducted the investigations, and each paid one-half of the expense. In June, 1910, the coöperative arrangement was discontinued, and since then, the Commission has carried on the work independently or under similar contracts with other institutions as seems most advantageous to the state. Under these arrangements, valuable assistance has been rendered by the Department of Agriculture and the Department of War, and several important and extensive projects have been successfully undertaken. In the promotion of this work, certain practical tests have been uniformly applied. A preliminary examination is made by the State Levee and Drainage Commissioner to ascertain whether a project is feasible, whether the community has taken the necessary steps to organize a drainage district, whether the organization if perfected appears practicable, and whether there is an immediate necessity for the survey. By this process of judicious elimination, six of the more meritorious districts were selected, and topographic maps have been prepared which represent an area of 101,077 acres. These maps, which are executed with the most painstaking accuracy and fidelity, have cost from 8½ to 10 cents per acre. Since the creation of this Commission, $62,000 have been appropriated out of the public treasury for carrying on the work. From the standpoint of the state, this is an unusually profitable investment. The total cost of reclamation to the state is generally 10 cents per acre, and it never exceeds 20 cents. At the increased valuation, the state is completely reimbursed for its outlay in from two to four years.

Illinois. Extensive drainage investigations have been undertaken in Illinois under the direction of the Internal Improvement Commission and the Rivers and Lakes Commission. The duties of the former as fixed by the statute are to investigate the reclamation of lands subject to overflow or inundation, and to accumulate such statistics as will enable the General Assembly to devise measures for their reclamation. The Rivers and Lakes Commission was created in 1911. It consists of three members, a civil engineer of recognized standing, a lawyer of extensive experience, and one other person intimately acquainted with the rivers and lakes of the state. This Commission is invested with extensive powers, conspicuous among which is the collection of drainage and reclamation data, which is furnished to any applicant at the actual cost of procuring it. Since their organization, these Commissions have coöperated with the United States Geological Survey and the expenses incurred have been paid at a ratio previously agreed upon. The investigations conducted have furnished valuable data as to the discharge or run-off of twenty-two of the more considerable and incorrigible streams of the state, including the daily and monthly discharge of water, and certain climatological statistics, including the aggregate precipitation, mean annual temperature, wind movements and relative humidity.

The first report submitted by the Rivers and Lakes Commission constitutes an elaborate plan for the reclamation of the overflowed lands of the Kaskaskia valley and one of its most important confluents, embracing an aggregate area of approximately 254 square miles, or 162,000 acres. This comprehensive report exhibits in detail all railroad and highway bridges, all artificial channels communicating with that stream, the maximum and minimum precipitation, the character of the soil, crops and timber, with data on the most destructive floods, and the power of resistance displayed by the existing levees; the quantity of land submerged at various points along the stream, the provisions already made for reclamation, the necessary rapidity of discharge to prevent the filling of the valley, the specifications for levees, and all cut-offs, bluff diversion ditches and sedimentation areas. Having accumulated this information, the Commission perfected a plan by which the whole valley may be reclaimed in such manner as to render possible the development of independent drainage units. Accordingly, the territory was divided into twenty-eight units, numbered from one to twenty-eight, the odd numbers on the right bank and the even numbers on the left, and varying in area from 600 to 15,000 acres. A detailed description, including the character, extent and estimated cost of reclaiming each unit, was then worked out. The total estimated cost of the entire project, including the correction of the main channel of the Kaskaskia and its confluent streams, the erection of levees, the construction of gravity outlets, and other contingent expenses, was $4,779,000, an average of $35 or $40 per acre; the estimated benefits ranged from 50 to 100%.

A similar study of the Little Wabash and Skillet Fork Rivers was undertaken in 1911. The estimated cost of reclaiming the 128,000 acres on these two streams is $662,000; the estimated benefits which will accrue are $5,100,000, or about 3½ times the entire cost of the work.

New York. The Conservation Department of the state of New York, which was created in 1911, is authorized to exercise extensive powers in the drainage and reclamation of swamp lands, but as yet very little has been undertaken in this direction, except to procure an important decision from the Supreme Court of Appeals relative to drainage affecting the public welfare.

Minnesota. The only state, with the possible exception of Texas, which has established a real, efficient drainage commission, is Minnesota. This commission consists of the Governor, the Secretary and Auditor of State, but in reality, its functions are delegated to an engineer, whom they appoint, and who is authorized to exercise extensive powers throughout the commonwealth. Aside from the construction of state drains for the redemption of state and private lands, they are required to make a comprehensive topographical survey of the state, to furnish accurate scientific data to any county applying for such information, and no county may undertake a reclamation enterprise until the plans are approved by the state Drainage Commission. This insures uniformity in all reclamation enterprises and is a guarantee that all drainage districts as they are successively created will supplement each other and form parts of an adequate, unified, mutually consistent and comprehensive system.

Wisconsin. Hereafter all plans for the reclamation of overflowed lands in Wisconsin will be inspected and approved by the college of agriculture of the State University.

AGENCIES WHICH ARE INTERESTED IN THE PROMOTION OF DRAINAGE. The agencies which have been chiefly instrumental in the promotion of drainage and reclamation enterprises are The National Drainage Congress, The Southern Commercial Congress, The Missouri Levee and Drainage Association, The Indiana State Board of Agriculture, and various other equally notable and active organizations throughout the country. The appalling flood which devastated the Ohio valley in 1913 aroused these organizations to a more vigorous and persistent activity. In a dispatch to the Chairman of the Executive Committee of the National Drainage Congress on March 27th, 1913, President Wilson said:—"The calamity in Ohio and Indiana makes clearer than ever before the imperative and immediate necessity for a comprehensive and systematic plan for drainage and flood control." In response, Mr. Edmund T. Perkins said:—"Knowing that such catastrophes are needless," the National Drainage Congress accepts the responsibility of "presenting to the people and the Congress of the United States a plan to alleviate and prevent the recurrence of loss of life and property."

The National Drainage Congress. An association known as the National Irrigation Congress has been in existence for 20 years. The chief interest of this organization is in the reclamation of waste and arid lands by irrigation. When its nineteenth annual meeting was held in Chicago in 1911, a strong sentiment in favor of land drainage manifested itself, and the need for a nation-wide movement, mutual agreement and concerted action to achieve tangible results, led to the organization on Dec. 7, 1911, of the National Drainage Congress, a separate and independent institution, designed to promote the reclamation of lands by drainage. The objects of this Congress as set forth in the constitution are to diffuse knowledge concerning the reclamation of lands, to promote navigation by means of canals built for drainage purposes and the streams into which they discharge their waters, to conserve and impound water for drainage and flood protection, to conserve and control natural resources pertaining to agriculture, to restore and preserve soils by the overflow of silt, to remove the menace to the public health constituted by undrained lands, to facilitate conferences and deliberations concerning drainage, and to provide means for bringing the needs of the people to the attention of the state and federal governments.

The Southern Commercial Congress. Among the newer organizations, none is more active, influential and public-spirited than the Southern Commercial Congress, a vigorous and thrifty organization now in its fifth year. This Congress is divided into sections, one of which devotes its exclusive attention to drainage. At its Fourth Annual Convention held in Nashville, Tenn., in 1912, resolutions were adopted designed to inaugurate an educational campaign to demonstrate to the people of the United States and to the owners of swamp and overflowed lands in particular the economic value of reclaiming these lands and making them fit for cultivation; to provide for the appointment of a Commission to simplify and standardize the drainage laws of the several states and secure their adoption by the several state legislatures; to petition Congress to institute a complete survey of all swamp and overflowed lands in the United States and to work out a comprehensive plan for drainage and conduct an examination of the soils and their adaptability to the growth of profitable crops; and to solicit the co-operation of all commercial organizations, railroads, banks, and business interests in carrying out this plan.

The agencies which were chiefly instrumental in the promotion of drainage in this state are the State Board of Agriculture, certain enterprising and public-spirited citizens, drainage associations, the organized association of tile makers, actuated largely by economic motives, physicians and others interested in the improvement of the public health, and the state itself. The activity of the State Board of Agriculture was commendable and noteworthy. Beginning with 1851 they offered a premium at the state fair for the best essay on the subject of drainage, and during the same year they sent out a list of questions to ascertain the condition of agriculture in this state, one of which related to the improvement of wet lands and the best and most economical methods employed in ditching and draining.

Federal Aid to Drainage. In 1850, Congress passed a law commonly known as the "swamp-land grant" which became effective on Sept. 28th of that year. By the provisions of that act all swamp and overflowed lands were granted to the several states in which they were located. The proceeds from the sale of these lands were applied exclusively, so far as necessary, to their reclamation by levees and drains. The intention of the act was to place the burden of draining on the lands themselves and not on the states or the Federal Government. In every state except Florida these lands speedily passed to private ownership; that state still retains 1,400,000 acres of the original grant, known as the Everglades, and is now actively engaged in reclaiming them This condition of diversified and widely distributed ownership is one of the serious difficulties to be overcome. During the last four years, bills have been introduced in Congress designed to secure Federal aid in the reclamation of these lands and the plan proposed is similar to that under which the Federal Government now reclaims the arid lands of the western states by irrigation. The theory is that "If the Federal Government has power to put water on the arid lands of the West, it has the same power to take the water off of the wet lands of the East." It should be noted, however, that the Federal reclamation act was passed primarily to reclaim the extensive area of arid public lands in the west and not for the reclamation of private property Since the swamp lands have long since passed to private ownership, a plan must be devised which originates with the people; private property may not be taken except for public use and then only by due process of law. Obviously neither state nor nation can enforce the drainage of these lands except under the police powers of the state to abate a public nuisance and safeguard the public health. But although the Federal Government has no power to compel owners to drain their swamp lands, yet it undoubtedly has the power to make surveys of these lands, to determine the approximate cost of reclamation, to develop an efficient and harmonious plan for the various projects as part of a complete system, to analyze the soil and ascertain its probable value when drained and where practicable or necessary to perfect plans for water transportation. Such a bill has been prepared by the National Drainage Congress and is now pending. This bill provides that all revenue derived from the sale of public lands in Alabama, Arkansas, Florida, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio, Wisconsin, and Alaska, beginning with 1901, including certain fees and commissions and excepting the 5% of such sales set aside for educational and other purposes, shall be appropriated as a Flood Protection and Drainage Fund, to be used under the direction of the Secretary of the Interior in the examination and survey for and the construction, operation and maintenance of drains, levees, tree planting and other works whenever needed for the prevention of floods, or the protection, drainage or reclamation of overflowed and swamp lands.

The Secretary of the Interior is authorized to make surveys and examinations, to locate and construct drainage works and to report to Congress annually the estimated cost of contemplated works, the practicability thereof, the quantity and location of such lands, the cost of works constructed or in process of construction and to withdraw any public lands from entry until they are reclaimed. When the Secretary of the Interior decides that any project is feasible, he may let the contract for the necessary works, provided sufficient funds have accrued. When the lands selected for reclamation have passed to private ownership, or when the surveys have been made and plans outlined for their reclamation, the Secretary of the Interior may grant the privilege to the owners to proceed with the drainage as a drainage district under the laws of the state in which they are located. If the reclamation of any tract of land selected is partly completed, the enterprise may be carried on by the Secretary of the Interior. If the tract selected is contiguous to state or private lands, such tracts may be combined in one district. Ownership of all works constructed is to reside in the government until all assessments are paid. If the contemplated drains when constructed will be large enough for navigation, the Secretary of the Interior may. with the consent of the states or the owners, refer the plans to the Secretary of War for examination by the Chief Engineer of the United States army as to their practicability for navigation waterways. If the Engineer approves of the plan a joint report will be made to Congress by the Secretary of War and the Secretary of the Interior, and if money is appropriated the two secretaries agree on a mutual plan of improvement. The system when completed will be subject to the same control as other navigable waterways. Interstate drains are similarly provided for, and the bill carries an appropriation of $20,000.000.

State Aid to Drainage. The question of direct state aid and centralized supervision of drainage has already assumed respectable proportions in several commonwealths, and circumstances and conditions in this state amply justify the exercise of some form of centralized authority to promote vigorously and systematically the redemption of unreclaimed and non-arable swamp lands, and to prevent effectually the lapsing of those convalescent or fully reclaimed. The commission or other authority intrusted with this important work should be required to perform other additional ancillary public functions, such as the supervision of all navigable and non-navigable rivers and lakes of the state, the conservation of water power, the adoption of measures to reasonably safe-guard the citizens of the state against such costly and destructive calamities as that by which they were prostrated during the past year, the making of surveys and the collection of data on natural resources, the prevention of encroachments on lake and river fronts or the pollution of streams and the ultimate establishment and control of public recreational parks. A wise and judicious consolidation of existing departments, and the utilization of the services of scientific experts already in the employ of the state, would render the creation of new offices unnecessary, and the results of their united efforts would abundantly repay the state for the meagre and inconsiderable outlay.

The agitation for the exercise and extension of the paternalistic powers of the state in this laudable and much neglected enterprise has expressed itself in two distinct but mutually consistent programs. The former calls for a vigorous centralized supervision of state conservation and reclamation, a plan which has already been successfully undertaken by Illinois, Minnesota, New York and Texas. The latter seeks to secure direct state aid in the correction of incorrigible and meandering watercourses and to provide subsidies, under proper restrictions, for enterprises of undoubted, imperative and meritorious validity. The state of Illinois definitely committed herself to this policy in 1913 by the appropriation of $339,000 to construct, repair and maintain the levees along the Mississippi and Ohio rivers which were demolished by the unparalleled floods of last year. Her action in this matter was inspired alike by necessity, economy and public policy. The tax levies of the cities to which this appropriation was made had already approached and exceeded the constitutional limitation; during 1912 and 1913 the state had already expended $160,000 in the protection of life and property in these exposed localities; while a wise and enlightened public policy renders the expenditure of money for such purposes an enviable and unique distinction. The sum of $3,000 was likewise appropriated to the village of Naples, on condition that a like sum be raised by that corporation. This money is to be expended under the supervision and direction of the Rivers and Lakes Commission and with the consent and approval of the Governor.

Aside from such imperative and obvious contingencies, competent and practical engineers, who have had extensive experience in this work, are inclined to the opinion that if state subsidies are granted, they should not only be rigorously supervised but should be confined exclusively to the improvement of the channels of watercourses, the removal of obstructions and debris, and the construction of cut-offs and should be administered and expended in the same manner in which Federal aid is now disbursed for the correction of navigable streams. Such assistance would not only impart a much needed stimulus to this important work by conquering the shiftless indifference of many landowners, but the value which would be added to real property would abundantly repay the state in taxes in a very few years.

A somewhat different form of state aid is that by which provision is made for small loans out of the public treasury. This system was instituted in England in 1829 under certain necessary restrictions, and was adopted by Maryland in 1912. By the provisions of the Maryland act, $10,000 was appropriated out of the state treasury to assist impecunious drainage districts in the prosecution of reclamation enterprises, not more than $2,000 of which may be appropriated for any single undertaking.

The record of the state of Indiana in such enterprises is far from enviable. On three separate and distinct occasions, money and services have been contributed to preserve state property from threatened impairment by the badly drained lands contiguous to the tracts on which public buildings were located. In 1837, the services of the State Engineer and his assistants were contributed to prevent the encroachment of floods on the state house grounds from the unreclaimed flood-plains of Fall Creek, now comprised within the corporate limits of the city of Indianapolis. In 1885, $500 was appropriated out of the state treasury to drain the grounds of the House of Refuge at

Plainfield, and in 1873, and again in 1883 provision was made for the drainage of the tract of the Prison North. In two instances, state officers have been authorized to exercise supervisory and inquisitorial powers over incorporated drainage associations. To prevent the practice of irregularities under the act of 1871, and to insure an honest and judicious expenditure of revenue and to guarantee publicity of all financial transactions, the governor was required to approve each and every issue of bonds; quarterly reports were made to the Auditor of State, and that officer was further required to institute an inspection of the company's books whenever a reasonable presumption of guilt existed. The trustees of the sanitary district in Lake county created by an act of the General Assembly of 1913 are required to make separate annual reports to the Governor and the two branches of the Legislature to insure a faithful, economical and judicious dispensation of the company's affairs.

State Aid in Indiana. The most notable and conspicuous examples of state aid and state supervision were those which attended the efforts of this commonwealth to reclaim the waste lands in the region of the Kankakee and Calumet rivers, and the Federal Swamp Lands granted to this state by virtue of an act of the General Government of 1850. Untold benefit has accrued to the people of this state by these three projects but their complete success has been seriously frustrated and perverted for reasons which will appear in the sequel.

The Kankakee Region. The agitation for the reclamation of the Kankakee swamp began as early as 1850. Persistent and ill-advised procrastination, however, delayed action in this important undertaking until 1881. Over $70,000 have been appropriated out of the state treasury to defray the cost of this project. This money has been employed in the examination and survey of contemplated drains, and for the removal of the Limestone Ledge, an obstruction a mile and a half in length and more than three hundred feet in width which impounded the water and constituted, together with the innumerable beaver dams, an insuperable obstacle to effective drainage. The work was supervised by commissioners and engineers appointed directly or indirectly by the governor. With the removal of these barriers the river flowed tortuous but unvexed to the state line, and artificial drainage proceeded with considerable rapidity. Even as late as 1911, however, an important obstruction existed in the river on the Illinois side, and a resolution of that year invoked federal aid and the cooperation of the state of Illinois in its removal.

The Calumet Region. In 1881, $6,000, to be expended under the joint supervision of the board of county commissioners of Lake county and the governor, was appropriated to remove a delta or sand bar from the Calumet river, at the mouth of the Hart or Cady state ditch, which had been accumulating for some years, and had finally assumed such dimensions as to seriously obstruct the river.

Federal Swamp Lands. The results attending the attempts to drain the Federal Swamp Lands were in many cases distinctly disappointing. By virtue of the federal swamp land act of 1850, the state came into possession of 1,378,000 acres of unreclaimed lands, for the redemption of which a sum aggregating $1,297,000 was expended. The legislation designed to promote this notable undertaking covers a period of 56 years, and at least 34 laws and 6 resolutions were adopted to provide for their sale and reclamation, and for the adjustment of claims and the perfection of titles. These lands were placed on the market in 1851 at $1.25 per acre, and fifteen months later, on May 29, 1852, and after an investigation had been made, a method of reclaiming them, which applied to seventy-one counties, was adopted. A swamp land commissioner was appointed by the governor in each county, who with the assistance of a competent engineer examined and surveyed the swamp lands and ascertained the cheapest and most expeditious method of drainage.

The results on the whole were rather unsatisfactory, and many counties complained that they had derived little or no benefit from the undertaking. Moreover, the opportunity for fraud in the sale of contracts and the practice of paying contractors for their work in land was too frequently taken advantage of, while the scandalous and disgraceful adventures of several prominent public officials in the misappropriation of public funds, renders this one of the most sordid and uninspiring chapters in our history.

DRAINAGE QUESTIONS PECULIAR TO INDIANA.

Redeeming the State. One of the most commonplace and unromantic, but certainly the most beneficial and far-reaching public enterprise ever undertaken by the citizens of this state has been the redemption and reclamation of the non-arable swamp lands. This enterprise has been carried on with unequal vigor for a period of one hundred and fifteen years, and there is tolerably authentic evidence that numerous unrecorded efforts were made even much earlier. These chronicled and unchronicled undertakings representing the tenacious and cherished ambitions of fully one hundred and twenty-five years, are recorded in two hundred and seven distinct laws and resolutions, and illustrated by the fragmetary and fugitive scraps of contemporary literature in which the annals of our history is preserved. Since the organization of political institutions in this state, at least one thousand drainage measures of varying and unequal degrees of merit have been seriously considered by our lawmakers, and months of time have been consumed in advocating their adoption or securing their defeat. Swarming with ambiguous, pernicious, impracticable, confiscatory and non-workable provisions as even the best intentioned and most skillfully framed statutes too frequently do, scores of judges throughout the commonwealth have bestowed their maturest thought to the vexing task of elucidating and interpretating these statutes, and a host of lawyers have found this one of their most lucrative and unfailing sources of revenue. The drainage achievements to date, representing the cumulative industry of fully five generations of men constitute a gigantic arterial system of subterranean and surface conduits, aggregating 320,000 miles in length, which ramifies and tesselates the whole extensive area of the physical commonwealth. This stupendous capillary system speedily conducts the superfluous accumulations of water from 17,000,000 acres of productive farms where it has been deposited by showers or left by melting snow. It has added untold millions to the wealth and prosperity of the state, improved the public health to an almost incredible degree, involved the annual expenditure of hundreds of thousands of dollars in its maintenance and augmentation, and afforded honorable, remunerative and profitable employment to an army of laborers, enterprising contractors, thrifty manufacturers and promoters.

NATURAL DRAINAGE AND PHYSIOGRAPHIC CONDITIONS. The state of Indiana comprises an approximate land area of 23,069,000 acres. The natural drainage systems are fairly adequate. The northern three-fifths of the state is heavily glaciated, and is drained into the St. Lawrence by means of the Calumet, the St. Joseph and the Maumee rivers and into the Mississippi by means of the Wabash, the Kankakee, the Illinois and their innumerable tributaries. When the territory was first visited by civilized men, the eastern half of this glaciated area consisted of spacious treeless meadows, some well watered, others dry and arid, supporting wild grass and wild hemp, alternating with deep woods, the open prairies predominating in about the ratio of three to one. The extreme northeastern part of the state is studded with some 2,000 small lakes and kettleholes, fashioned during the glacial epoch, and preserved by the peculiar disposition and arrangement of the lateral and terminal moraines. The western half, between the Wabash and Lake Michigan, is a succession of woodlands, prairies, lakes and swamps. The savannas of this region are of two kinds: Untimbered alluvial flats, and upland prairies, rising to an altitude of 50 to 150 feet above the neighboring bottoms, and presenting an undulating and ridgy surface. The soil of both is of inexhaustible fertility.

The southern two-fifths of the state is non-glaciated and is more predominately rugged and hilly. It is drained exclusively into the Mississippi by means of the Ohio and the Wabash and their confluent streams. During the pioneer period, the country along the Wabash and its tributaries was a succession of swamps, morasses, and beaver ponds, indescribably rich, alternating with high ground and small savannas, badly watered. These swamps or wet prairies consist of spongy, alluvial deposits, superimposed on a stratum of unporous clay. They are from four to six miles in width traversed by countless small sluggish streams and were subject to destructive periodical inundations which frequently extended for a distance of six or seven miles from the river and rose to a height of ten feet. By the accumulation of settling alluvium, these periodical inundations enhanced the fertility of the bottom lands, rendered them increasingly valuable possessions, and induced the settlers, in spite of the inevitable hazard involved, to fix their habitations in close propinquity to the main stream. The peril to which an unexpected rise of the river exposed them, stimulated the earliest recorded enterprises to deepen and straighten the more inconsiderable watercourses, and to erect artificial obstructions along the banks of the main streams, a species of activity which has continued to be the predominant drainage characteristic in this portion of the state for over a century, and is still pursued with unabated vigor.

DEVELOPMENT OF ARTIFICIAL DRAINAGE. In drainage, as in all other forms of industry, there has been a progressive development from individualism, the predominant characteristic of the eighteenth century, to the collective cooperation and paternalism of the nineteenth and twentieth centuries. The earliest recorded efforts to reclaim submerged or non-arable lands were promoted by individual land owners, each pioneer redeeming a few precarious acres by the erection of feeble barriers against the encroachments of floods, or conducting the stagnant and unwholesome water from his land by the construction of shallow artificial channels. This method was inadequate, laborious, expensive or even prohibitive where an outlet had to be obtained across the land of obstinate, selfish, unfriendly or recalcitrant owners. This insuperable obstacle made cooperation desirable or imperative, and communistic action promptly succeeded. These gregarious enterprises were originally confined to the more favored, fertile, and thickly populated localities of the state, possessing mutual and unconflicting interests. The area which they were designed to redeem rarely exceeded a few hundred acres in extent, and their success depended on the voluntary and mutual consent of all interested owners. Beginning with one farm, or at most a few contiguous farms, which could be successfully and advantageously drained by the construction of a single system disemboguing into a convenient and uncontested outlet, the next step was to extend the application of the law to a territory co-terminus with an entire county. Within the county, naturally, several distinct and unconnected systems would be established, but its operation was uniform throughout the designated territory. The first state-wide drainage act was passed in 1852 after the adoption of the new instrument of government during the preceding year had rendered special legislation unconstitutional and invalid. Provision has subsequently been made for the construction and maintenance of inter-county and inter-state ditches, drains and levees. These state-wide drainage acts have been repeatedly and wisely differentiated to meet the needs of the various parts of the state both rural and urban and finally in one notable and in several unimportant instances, the commonwealth has exercised supervision and extended direct state aid to the promotion of drainage enterprises.

One of the expensive and inevitable blunders committed by early drainage promoters was the construction of drains of insufficient magnitude to adequately perform their functions In 1851, Governor Wright expressed it as his matured conviction that drains two feet deep and two feet in width were of sufficient capacity to redeem most of the unreclaimed swamp lands, and the ditches of that period and even as late as 1870 were seldom larger. Gradually the necessity for larger drains became imperative and ditches four, six and ten feet in depth were not uncommon.

METHODS EMPLOYED IN DRAINAGE. Four methods of drainage have been successfully and continuously employed in this state: (1) Open ditches; (2) Subterranean, underground or blind ditches; (3) Dams, embankments, or levees, in connection with which accessory pumping plants and sluice-ways have frequently been installed; and (4) The utilization of natural streams and water courses, by straightening, widening, deepening and removing obstructions from their channels.

Open Ditches. The method of draining land by open, sloping, hand-dug ditches was introduced in this state as early as 1799, but such drains were not constructed extensively or systematically by mutual cooperation prior to 1835. Such ditches were usually constructed twice as wide at the top as at the bottom, and from two to six feet in depth. When the ground was loose and friable, or consisted of gravel, alluvium or muck deposits, the work was done exclusively by hand; where the earth was more compact, plows were used to loosen the soil, and it was then thrown out with shovels. The introduction of the floating steam dredge has rendered this form of hardy enterprise less arduous, materially reduced the cost, and rapidly promoted the redemption of the non-arable lands. Open drains are constructed at the rate of about 1,500 miles per year. Prior to 1884, few counties in the state had over 1,000 miles each. There are probably 75,000 miles of open drains in operation in this state at the present time.

The Ridge and Furrow Method. The ridge and furrow method of drainage has been used extensively in all parts of the state, and is still widely employed. When there is sufficient fall, the land is plowed in beds or ridges, from 15 to 30 feet in width, divided by furrows or trenches 20 inches wide and 18 inches deep, run in parallel lines and at a slight angle to the plane of inclination of the ground. The excess surface water drains off quickly through these furrows.

The Shaft Method. The so-called shaft method is sometimes employed in impervious clay soils. Shallow ditches are dug, and the bottoms pierced at appropriated intervals, through which the water easily escapes to the porous substratum.

Subterranean, Underground or Blind Ditches. The method of draining lands by the construction of subterranean or underground drains, was introduced in this state about 1841. Underground drains are preferable to open drains because the trench can be filled in and farmed over. Of all types of subterranean conduits, the tile drain is deservedly the most popular because of its convenience, durability, efficiency and economy. Before tile were invented and manufactured, however, several varieties of underground drains were extensively and successfully employed.

(1) *Brush Drains.* The brush drain was probably the cheapest form of underground drain ever devised, but not very durable. A trench of proper dimensions was dug and then filled with brush to a depth of 18 inches and the earth replaced. This form of drain was used extensively from 1853-1860 and even much earlier.

(2) *Stone Ditches.* Drains constructed with stone have been widely employed in many parts of the state. Trenches were dug from 6 to 24 inches in width at the bottom and from 2 to 6 feet in depth, depending on the nature of the soil, being shallow in clay soils and deep in black or alluvial deposits. These ditches were then curbed on the sides with cobble stones, four or five inches in diameter, laid up loosely without mortar and surmounted by large flat stones, laid across the top to enclose the channel thus formed. Sometimes two layers of cobble stones were used. The channel or duct when completed and enclosed was from 4 to 10 inches in width and from 6 to 15 inches in depth. The dirt was then replaced. Sometimes cobble or broken stone were thrown into the trench, without order to a depth of several inches, covered with brush or straw to exclude the debris, and then filled in with dirt. In some

cases the wall of the ditch was cut with a shoulder of earth and flat stones laid thereon. These ditches were very economical and satisfactory where limestone, sandstone, or slate abounded. They cost from 20 to 50 cents per rod, depending on the accessibility of stone. They were used extensively during the decade preceding 1860 and only went out of use when tile became cheap and abundant. Where stone was not plentiful or available, brick or even sod were used. The cost of brick curbed ditches in 1860 was about twenty-eight cents per rod.

(3) *Timber Ditches.* Trenches for timber drains were dug from 18 to 30 inches deep, and from 16 to 30 inches wide. Oak slabs, strips or puncheons, either split or round, were then prepared, from 14 to 30 inches long, 1 1-2 to 3 inches thick, and as wide as the tree or sapling from which they were split. These slabs were then placed in the trench and leaned obliquely in such manner that one end was set firmly against the bottom at one side with the top resting against the opposite side, and reaching within 8 or 10 inches of the surface, and below the ordinary depth of plowing in such manner as not to interfere with cultivation. The dirt was then replaced, leaving a triangular shaped channel through which the water readily escaped. Sometimes a trench was constructed 30 inches wide and 20 inches deep, in the bottom of which a channel was cut, 12 inches wide and 12 inches deep, leaving a shoulder 9 inches wide on either side, on which planks were placed. Another method was to cut a notch or groove in either side of the trench, 12 inches from the bottom, insert cross pieces of proper lengths, and place saplings 4 to 10 inches in diameter thereon, lengthwise of the ditch. Long rectangular boxes constructed of plank were frequently used. Drains constructed of wood lasted about 10 or 12 years and cost from 16 to 75 cents per rod. An experiment treating chestnut boards with vapor of carbolic acid to preserve them from decay was made in 1869. The success of this experiment seemed to demonstrate temporarily that

timber for drainage purposes was preferable to and cheaper than brick tile. From 1850-1865, and while timber was still abundant, many timber drains were constructed, but as they fell into disuse, they were gradually superseded by tile drains.

(4) *Ditching Machines.* Ditching machines have been used in this state with indifferent success since 1840. The sub-soil or mole-plow achieved the widest popularity. The mole-plow was a machine so constructed as to lift the soil, and produce a duct or passage for water from 12 to 36 inches underground. From four to six yoke of oxen and a capstan were required to draw it, and from 60 to 100 rods of ditch could be completed in a day, at a cost of 16 to 25 cents per rod. The mole-plow was used extensively in some parts of the state from 1850-1860.

(5) *Tile Drainage.* The first experiments with tile drainage in the United States were made on the borders of Seneca Lake, near Geneva, New York. This fact and the beneficial results attending the experiment were widely proclaimed by the agricultural papers of the country, and farmers in other states tried it. The first machine for the manufacture of drain tile from clay was introduced into this country by Professor Norton of Yale, and similar machines were introduced into this state about 1850. A tile machine was operated at Fort Wayne during 1853, and about the same time a factory was established in Johnson county and another in Franklin county. At first these machines were operated by hand, later by horse power, and finally by steam.

The first tile placed on the market were the so-called horseshoe tile bent into a little less than a half circle, resembling a horseshoe, with open bottoms, drawn out to a distance of 3 or 4 inches on each side, sufficient to form a flat surface to rest on. These tile invariably sank and became disarranged. To insure stability, plates one inch thick and eight or ten inches wide, called soles, were used to lay them on, and finally the sole was attached to and made an integral part of the tile. Such tile with wide, flaring bottoms were objectionable because the stream of water which flowed through them was spread out so wide and rendered so sluggish that it did not flush out the increasing accumulations of silt. Sole tile with round cavities were next used, and finally the sole was discarded and round or pipe tile were used exclusively. Collars were at first used with round tile to effect a more perfect articulation of the joints. It was soon discovered that these collars obstructed the free access of the water and they were soon discontinued.

From 1850-1860 brick tile were expensive and infrequently used. They won their way slowly through a period of skeptical experimentation to popularity, and by 1865 they had become an established and indispensable institution. Gradually as the old wood and stone drains fell into disrepair, they were replaced by tile drains, but public sentiment yielded so reluctantly to the innovation, that they had not achieved a complete, state-wide triumph until 1890. From 1860-1880, the tile used were very small and much of the work had to be done over.

There were 31,000 miles of drain tile in operation in this state in 1882; in 1895 the last year for which statistics are available, there were 134,593 miles. The average annual increase has been approximately 6,500 miles. If the progress of this industry has gone on since 1895 with the same portentous rapidity, there are not far from 245,000 miles of drain tile in operation at the present time.

One evidence of the growth and multiplication of tile drains was the enormous increase in the number and output of the tile factories. In 1860, there were 20 tile factories in the state and during the ten years from 1860-1870, 58 new ones were established. By 1880, the demand for tile had greatly exceeded the supply and factories were being established rapidly in every county in the state, and tile makers were becoming more active and diligent in the promotion of their industry. Beginning with 1876, they held semi-annual meetings at Indianapolis. There were 297 drain tile establishments in the state in 1879 and 545 in 1885, the last year for which statistics are available. The value of the drain tile manufactured during this same period aggregated $6,300,000, over 2,000 men were employed and the yearly wage approximated $500,000.

Levees, Dams and Embankments. The lands contiguous to streams and watercourses are reclaimed by the erection of artificial obstructions known as dams, levees, or embankments. The first levees constructed in this state in the vicinity of Vincennes were composed of yellow sand and did not exceed three feet in height. The work is usually carried on by levee associations.

The Utilization of Natural Streams and Water-courses The utilization of natural streams and water courses has been a favorite method of drainage from the beginning. When the natural channel is deepened, widened and straightened the value of the stream is increased many fold.

Ditch Taxes Imposed. The revenue raised by taxation for the promotion of drainage is but a tithe of that contributed by individuals to whom the benefits directly accrue. However, during the twenty-two years from 1889-1911, inclusive, the several counties of the state expended as their respective shares of drainage projects the sum of $2,400,000. In some counties a tax, appropriately designated, is regularly imposed to create a ditch fund. In 1911, such a tax was collected in twelve townships in Spencer, St. Joseph, Wabash, Wayne and Whitley counties, and since 1907 the revenue which has been covered into the treasuries of these counties from this source aggregates $332,000.

Classification of Drainage Acts. For convenience, the drainage acts and resolutions of the territorial and commonwealth periods may be grouped into four distinct classes: (1) The highway drainage acts, passed between 1799 and 1883; (2) The special drainage acts passed between 1799 and 1852; (3) The state-wide drainage acts passed between 1852 and 1913; and (4) The acts designed to extend direct state aid or exercise administrative supervision, including the sale and redemption of Swamp Lands, the removal of obstructions from the Kankakee and the Calumet rivers, and the improvement of the tracts of the Prison North and the House of Refuge.

A PUBLIC ENTERPRISE INVOLVING INCIDENTAL DRAINAGE. The natural drainage systems of the state performed their functions inadequately. No artificial drainage had been undertaken except such as was promoted by private enterprise. The public highways of the state prior to 1800, and even much later, were abominable, and rarely passable for vehicles until the beginning of summer. Of the five paramount motives advanced for undertaking drainage, that one which had for its acknowledged object the improvement and preservation of the public roads and highways manifested itself the earliest. The Territorial Legislature devoted considerable attention to this subject, and the work was taken up and vigorously promoted by the General Assemblies of the Commonwealth. Twelve highway laws providing for incidental drainage were passed, covering a period of eighty-four years, from 1799 to 1883, inclusive. By the provisions of these acts, road supervisors or road masters were authorized, under the direction of the Court of General Quarter Sessions of the Peace, the Court of Common Pleas, or the several Boards of County Commissioners, to construct and maintain ditches or drains on the lands lying adjacent to the roads intrusted to their charge and of sufficient capacity to preserve such highways from disintegration. Although the paramount motive for constructing these drains was to expedite and facilitate the construction of roads and preserve them from destruction when completed and only incidentally to convey stagnant and subterranean water from the contiguous territory, it can scarcely be doubted that hundreds of acres throughout the state were reclaimed and rendered arable, and that the outlet afforded to private drains, so constructed as to discharge their water therein, has been of incalculable benefit to the citizens of this commonwealth.

THE SPECIAL DRAINAGE ACTS PASSED BETWEEN 1799 AND 1852. Every drainage project undertaken prior to 1852 was authorized and promoted by special legislation. During a period of 53 years, beginning with 1799, 38 acts and resolutions were passed, designed to provide for the drainage and reclamation of eighteen counties and thirteen small and widely separated areas.

1. The small and isolated areas whose drainage was provided for. The thirteen small and isolated districts whose drainage was provided for included Lower and Cathrenettes Prairies, located near Vincennes, in Knox county; Lost Creek in Vigo county; the low lands lying immediately northeast of the city of Indianapolis; the low lands near Center Lake in Steuben county; Round Pond in Eel River, Clay county; Blue River in Shelby county; Shaker Prairie in Knox and Sullivan counties; Jordon Creek in Honey Creek township, Vigo county; Turtle Creek in Sullivan county; the Wabash River in Honey Creek and Prairie townships, Vigo county; Peru and Upper Peru Prairies in Miami county; the town of Cannelton in Perry county; and finally one, Reason W. Prather, was authorized to construct a ditch across a state road in Bartholomew county.

(a) *Reclamation of Lower and Cathrenettes Prairies, Knox County.* If we except the drainage achieved by the construction of ditches designed to enhance and improve the quality of public roads and highways, the first real reclamation enterprise was undertaken in 1807, somewhat more than eight years after the first road law was passed and fully nine years before Indiana was admitted to the Union. By the mutual cooperation of the owners, proprietors, and inhabitants of a portion of Lower Prairie, Knox county, comprehended within an accurately described periphery, an inconsiderable alluvial flat, not above a few hundred acres in extent, situated below Vincennes, contiguous to the Wabash river, and subject to periodical inundations, was reclaimed and protected from submersion by the erection of an artificial obstruction of sufficient magnitude to effectually restrain the waters of that stream. This obstruction was a levee, dyke or embankment composed of earth, stones and yellow sand, eight feet wide at the base, two feet high on a level and six feet wide on top, situated as near the brink of the high bank of the Wabash as appeared necessary and convenient, and extending from the boundary of the town lot of the heirs of Chapard, along the meanders of the Wabash, to the boundary line of Bray's land, and from thence over the most advantageous ground to the nearest highland at the southern bend of the Grand Caulee. From this rather obscure geographical terminology, it is difficult to determine either the length of the dyke or the extent of the riparian lands reclaimed by this primitive and inconspicuous drainage enterprise. The location of this dyke remained unchanged for a period of more than forty years, except for two rather important extensions of the embankment. Its significance lies in the fact that it was the first of a long series of enterprises designed to promote the reclamation of the state.

(b) *Lost Creek, Vigo County.* Lost Creek, an unimportant tributary of the Wabash, enters Fort Harrison Prairie about four miles northeast of Terre Haute. During freshets and periods of unusual precipitation, it overflowed its banks and spread over a scope of territory many miles in extent, producing sickness and destroying property. On January 21, 1837, a complete survey of Lost Creek and the adjacent territory was authorized. Embankments of sufficient height to confine the stream to its channel were erected, and a dam, calculated to regulate the discharge of water, was constructed.

(c) *State House Square, Indianapolis.* In 1837 the overflow from the swamps and low lands lying immediately northeast of the city of Indianapolis encroached on the State house square on the west, north and northeast sides. An act of Feb. 4, 1837, authorized the redemption of these lands and the cost was defrayed by subscriptions or voluntary contributions.

(d) *Center Lake, Steuben County.* On Feb. 17, 1838, Thomas Gale and others were authorized to drain the low lands around Center Lake, northwest of Angola, in Steuben county, by lowering the lake.

(e) *Round Pond, Clay County.* Round Pond was an inconsiderable artificial body of water formed above the feeder dam on Eel river in Clay county. The outlet of this stream had become seriously obstructed by the accumulation of trees, timber and debris. Valuable agricultural lands were submerged, and the presence of a stagnant pool of water contributed to the unwholesome condition of the neighborhood. By an act of Feb. 8, 1841, the formation of a drainage association was authorized, designed to locate and construct a ditch on the most economical and advantageous route and in such manner as to empty the waters of Round Pond into Eel River far enough below the feeder dam as not to interfere with the water power or the erection of machinery for its free and unobstructed use. The cost of the enterprise was defrayed by voluntary subscriptions.

(f) *Leveeing Blue River, Shelby County.* A faulty and unsatisfactory statute, not sufficiently explicit to outline a definite line of procedure, was passed on January 10, 1845, to provide for the leveeing of either side of Blue River in Shelby county, to protect the agricultural interests of the territory affected.

(g) *Shaker Prairie, Knox and Sullivan Counties.* Several voluntary and extra legal efforts had been made to reclaim Shaker Prairie in Knox and Sullivan counties. A contract had been entered into between the citizens of Shaker Prairie and one, Solomon Wolfe, to carry out this project. Symptoms of disaffection and incoherence in the organization resulted in the inability to enforce contracts and compel the payment of benefits and eventuated in the passage of a law placing the enterprise on a more substantial foundation. This act, which was passed on January 14, 1846, provided for the construction of embankments or levees along the Wabash river where it traverses Shaker Prairie, between two designated points, and at the joint expense of the owners of the land in the Prairie, in proportion to their respective benefits. The work already accomplished was accepted and legalized.

(h) *Jordon Creek, Honey Creek Township, Vigo County.* An act was passed on January 15, 1846, to define, deepen, change and alter the channel and levee the banks of Jordon Creek, Honey Creek township, Vigo county.

(i) *Turtle Creek, Sullivan County.* Turtle Creek in Sullivan county is an unimportant affluent of the Wabash. It had no well defined channel and during times of high water valuable lands were overflowed for a considerable distance from the parent stream, and troublesome and serious sickness produced. An artificial channel, called the canal, had been devised to remedy this mischief, but it performed its functions inadequately and on January 19, 1846, an act was passed providing for the definition of the channel of this stream between two designated points and the construction and maintenance of an artificial channel with which the one already constructed was incorporated.

(j) *Wabash River, Honey Creek and Prairie Townships, Vigo County.* Several unrecorded efforts had been made to redeem the riparian lands along the Wabash river in Honey Creek and Prairie townships, in Vigo county, by the erection of an embankment. This embankment had fallen into disrepair and no longer conformed to the meanders of the stream. Accordingly an act was passed on Feb. 16th, 1848, designed to authorize the repair, enlargement and straightening of this levee between two designated points and to provide for the construction of additions and extensions thereto.

(k) *Peru and Upper Peru Prairie, Miami County.* An act was passed on Dec. 22, 1849, providing for the drainage of Peru Prairie in Miami County by constructing a ditch between two designated points, and removing the obstructions from Lafountain's Creek below the point of its intersection with the ditch. The provisions of the same act were extended to Upper Peru Prairie, an intimate and contiguous part of the same non-arable territory.

(l) *Reason W. Prather.* One of the most curious legislative enactments of this entire period was that of January 15, 1851, which authorized Reason W. Prather of Bartholomew county to construct a ditch across the state road leading from Columbus in Bartholomew county to Rockford in Jackson county in order to drain certain low lands. Prather was required to do all the work, bear all the expense and account for all damages sustained.

(m) *Cannelton Levee and Draining Company.* The last of this series of special acts, providing for the incorporation of the Cannelton Levee and Draining Company was approved on January 21, 1851. This company was authorized to construct a levee around that portion of the town of Cannelton which was subject to inundation from the highest freshets of the Ohio river and its tributaries, to build suitable dredging machines and to install sluiceways to discharge the water which might accumulate within the levee. The capital stock was fixed at $20,000; the incorporation was to run fifty years unless sooner dissolved by its own voluntary action; and it was entitled to 10 per cent. on the original cost of the work, above operating expenses and upkeep. The owners of all lands and buildings within the area of the highest flood and protected by the levee were assessed to defray the cost and expenses.

2. The County Drainage Acts. The eight county drainage acts, providing for the reclamation of swamp or waste lands within fourteen designated counties, including Vigo, Tippecanoe, Montgomery, Clinton, Warren, Carroll, White, Spencer, Allen, Vanderburgh, Cass, Pulaski, Fulton and Adams and extending over a period of a quarter of a century, from 1827-1852, may be briefly summarized. On several occasions prior to 1820, road districts had been authorized to use a portion of their road fund to remove obstructions from streams and rivers and to effect an improvement in navigation. In conscious imitation of this procedure, an act was passed in 1827 to enable the citizens of Vigo county to appropriate their entire road fund, not to exceed one-half of the labor due to each road district, and such contributions and donations as might be made for the removal of stagnant water from any part of that county. In 1832, the drainage of swamp lands was authorized in Tippecanoe, Montgomery, Clinton and Warren counties when it was necessary to cross adjoining lands to secure an outlet. This was the first time in the history of drainage legislation that the right of eminent domain was directly invoked. In 1835, the benefits of this act were extended to Carroll and White counties, in 1838, Thomas Gale and others who wished to drain the low lands around Center Lake, northwest of Angola, in Steuben county, were authorized to avail themselves of its provisions and in 1841, it was extended to Spencer county. According to the provisions of these acts all expenses and damages were paid by the applicant, and he was required to bear the entire cost of construction and maintenance. In 1846, a similar act was passed providing for the drainage of swamp lands in Allen county; in 1848, relief was extended to the owners of non-arable lands in Vanderburgh, Cass, Pulaski, and Fulton counties, and in 1850 the last of the series of county drainage acts extended the provisions of the act of 1848 to Adams county.

THE STATE WIDE DRAINAGE ACTS PASSED BETWEEN 1852-1913. From 1852-1913, inclusive, 118 drainage acts and resolutions have been passed, sixteen of which, pertaining to highways, and to the Kankakee and Calumet rivers and the Prison North and the House of Refuge, will be considered in another connection. For convenience of treatment the remaining one hundred and two acts may be divided into the following classes: Incorporated drainage associations, Unincorporated drainage associations, Drainage of cities, Streams and natural water-courses, Maintenance and repair of drains, Inter-State drains, Protection of fresh-water lakes, Sanitary and drainage districts, and certain miscellaneous drainage acts.

1. **Incorporated Drainage Associations.** Laws designed to authorize the incorporation of drainage associations for the construction and maintenance of levees, drains and breakwaters, and the improvement and repair of natural streams and water courses and previously constructed drains, have been in operation since 1852, and for eleven years this was the only way in which drainage was promoted. Since 1911, the provisions of this act apply exclusively to levees. From 1893 on for a dozen years, the formation of drainage districts where lands required a combined system of drainage was in vogue.

2. **Unincorporated Drainage Associations.** The method of reclaiming land which has been most widely and extensively employed is by voluntary and unincorporated drainage associations. The authority to establish drainage works resides in the boards of county commissioners and the circuit and superior courts, and this authority is invoked on petition of certain public officers and of any interested person or group of persons. The administrative organizations empowered to determine the necessity and feasibility of any proposed drainage project and recommend the distribution of assessments for benefits and damages have differed considerably, but two distinct and well defined types have gradually evolved. From 1863-1905 this function was performed by three disinterested Viewers, appointed by the board of county commissioners. The present plan was instituted in 1881, and completely superseded the older method in 1905, when a consolidation of the drainage acts was perfected. The present act provides for a county drainage board consisting of an experienced county drainage commissioner, appointed biennially by the board of county commissioners, one commissioner appointed from the township in which the proposed drainage system

is located, and the county surveyor, who is ex-officio a member. This board combines skill and experience with familiarity with local conditions, and insures disinterested unity of action.

3. Drainage of Cities. Some twenty laws have been passed providing for the drainage of cities. These laws are designed to extend the authority of the municipality beyond its corporate limits, to authorize the construction, maintenance and repair of drains and levees and the removal of obstructions from streams and to empower adjoining cities to enter into agreements to promote systems of drainage which are mutually advantageous.

4. Streams and Natural Water-Courses. Natural streams and water courses both promote and retard drainage. When they are shallow, sluggish, obstructed and tortuous, they constitute a menace, but their improvement and utilization has often been more economical and advantageous than the construction of artificial channels. To capitalize this asset, acts have been passed at various times providing for the dredging, straightening, changing of the course or the removal of obstructions, drift and debris from the channels of such non-navigable streams and the erection of protecting walls to secure the adjoining lands from piratical and predatory intrusions of the water.

5. Maintenance and Repair of Drains. The earliest laws made no provision for the maintenance and repair of public drains, and it was only when the channels had become choked and obstructed and when the lands once redeemed had relapsed that the matter was given serious consideration. The work of maintenance and repair has sometimes been entrusted to the county surveyor and sometimes to the several township trustees. The method of distributing the necessary labor by proportionate allotments has usually been employed, but contracts for the entire work are sometimes sold. Open, hand-dug ditches are usually repaired annually or biennially; dredge ditches are cleaned at intervals of five years or when a petition for that purpose is filed by the interested persons.

6. **Interstate Ditches.** The earliest laws imposed a serious handicap on citizens of the state owning non-arable lands adjacent to state lines, and this barrier to effectual drainage was not removed until 1891 when the construction and maintenance of inter-state drains by mutual cooperation of the citizens of both commonwealths was provided for and the procedure in such cases was not fully perfected until 1913.

7. **Protection of the Fresh Water Lakes.** The powerful conservation movement of the last few years, combined with less worthy motives, led to the passage of a law in 1905 providing for the protection of the fresh water lakes of the state and the maintenance of their natural level.

8. **Sanitary Districts.** The General Assembly of 1913 authorized the incorporation of a sanitary and drainage district in Lake county whenever a majority of the qualified resident electors of the proposed district vote favorably on the proposition at a special election to be held for that purpose. This district, when organized, will cooperate with other similar districts in the contiguous counties of Illinois to promote a combined system of inter-state drainage and sewerage by means of the natural outlet through the Illinois river. The management of the district is entrusted to a board of five trustees, elected every four years.

9. **Miscellaneous Drainage Acts.** A multitude of miscellaneous drainage laws enacted during the past twenty-five years have perfected and effectualized the drainage code by affording relief in cases where the ambiguity of the statute fomented controversy and litigation, providing for the disposition of excess drainage funds, and the cancellation of unused drainage assessments, prescribing the duties of county surveyors in certain cases, making malicious injury done to drainage works a public offense, authorizing the reclamation and purchase of the submerged

lands bordering on Lake Michigan, providing for the construction of flood-gates to obstruct the retrograde action of water during floods and freshets, authorizing the establishment of tributary drains communicating with and discharging their waters into previously constructed drains, and providing for the tiling of existing public open drains.

THE NEWER AND MORE NOTABLE PROVISIONS OF THE STATE DRAINAGE LAWS.

A detailed study of the various state drainage laws is manifestly impossible in an abridged treatise. Besides, there is a certain uniformity in all these statutes and their composite, essential and irreducible provisions are sufficiently described in the Model Drainage Law, a study of which appears elsewhere in this Bulletin. Among the newer, exceptional and more notable provisions the following are worthy of enumeration.

THE AUTHORITY TO INITIATE DRAINAGE. The establishment of public drains for the reclamation of agricultural lands depends invariably on the application of a certain designated per cent of the interested owners, usually a majority. In Oklahoma, if the drain is designed primarily for the benefit of the public health, the signatures of 15 per cent. of the owners, owning 15 per cent of the land, is sufficient. In Ohio, if the State Board of Health finds that a drain is necessary for sanitary purposes, the County Commissioners make the necessary surveys and perfect plans and when these plans are approved by the State Board, the Commissioners proceed with the construction. The New York Conservation Commission is authorized to undertake drainage enterprises on its own initiative if they are of sufficient importance to warrant the interference of the state. The County Commissioners of the several counties of New Mexico are authorized to levy and collect a tax, not exceeding one mill on the dollar, to be expended in the drainage of swamp lands, flooded districts, or stagnant marshes which are a menace to the public health. Any county in Kentucky is authorized to remove stagnant water or reclaim marshes that may cause sickness and defray the expense out of the county revenue, or any part of a county may be created into a separate taxing district for that purpose.

PUBLIC SUBSIDIES. In South Carolina, if the public health is seriously affected by the condition of any water-course, improvements may be undertaken on application of one-third of the owners, residing within two miles of the stream and two reputable physicians, one of whom practices in the neighborhood and if the cost of the betterment cannot be reasonably borne by the interested owners, the excess is charged to the county and paid out of the general revenue. In New Jersey, if the cost of constructing any drainage works exceeds the benefits to the lands affected, the excess is raised by general taxation.

CO-OPERATION WITH THE UNITED STATES GOVERNMENT During the last half dozen years, several states, including Georgia, South Carolina, and Maryland, have provided for co-operative action with the United States Government in the promotion of drainage enterprises.

CENTRALIZED SUPERVISION. The following states maintain drainage boards of varying and unequal degrees of merit which are authorized to exercise their functions throughout the entire commonwealth: Minnesota, Texas, Illinois, New York, Florida, California, South Dakota, Oregon, Louisiana, New Jersey, Kansas, Washington and North Carolina.

The State Board of Drainage Commissioners of Florida is authorized to supervise the construction of drains anywhere throughout the state, to prepare lists of unreclaimed alluvial and swamp lands, and to levy a tax of not to exceed ten cents per annum per acre to defray all expense involved. The Conservation Commission of California is empowered to accumulate information on the subject of drainage and reclamation. In South Dakota all of the larger drainage enterprises must be approved by the State Engineer. The State Land Board of Oregon is authorized to contract for the drainage of lakes, marshes and swamps and to sell the lands when reclaimed. Beginning with 1913, the petition for any drainage enterprise in the state of Wisconsin must be accompanied by a favorable report of the State College of Agriculture on the quality of the soil, the feasibility of drainage and the probable costs and benefits. The Board of Managers of the Geological Survey of New Jersey, on application of at least 5 interested land owners, are authorized to examine the designated swamp tracts, make the necessary surveys, and adopt a system of drainage and report to the state supreme court. In Kansas, all plans of reclamation are submitted for approval to the School of Engineering of the State University or the Agricultural College. In 1913 the state of Washington created a Department of Agriculture. Among other duties, this Department is required to make surveys and classifications of such lands as are in need of reclamation and Agricultural Development Districts may be created to effect their redemption. In South Dakota all work is done under the supervision of the State Engineer and in North Carolina the engineer of any local drainage enterprise is appointed on recommendation of the State Geologist.

SERVIENT DISTRICTS. Several states, including Illinois and Idaho, provide for the articulation of upper and lower or servient drainage districts in order to secure adequate outlets and develop progressively larger drainage units.

OWNERSHIP OF MACHINERY. The statutes of several states provide for the purchase of dredge machines by drainage districts or corporations. In Delaware, this policy is determined by two-thirds vote of the persons interested, and in Wisconsin on petition of a majority of the owners.

COUNTY DRAINAGE BONDS. At the general election of 1914, a constitutional amendment will be voted on by the people of Michigan permitting any county to issue bonds to raise money for the construction of drains and the improvement of agricultural lands.

COUNTY DRAINAGE COMMISSION. In South Carolina, upon request of a majority of the senators and representatives of any county, the Governor appoints not less than three nor more than five resident freeholders as County Drainage Commissioners, for terms of four years. These Commissioners exercise control over all the drains of the county; they may require owners through whose lands private drains pass to connect these drains with a public ditch in harmony with the general system of the neighborhood, provided the cost does not exceed one-fourth of the land value; if lands are in an unsanitary condition, they may require the owners to drain them if the cost does not exceed one-half their value; in carrying out any of these enterprises, they may utilize the chain gang of the county to do the work.

WATER POWER. Invariably under the newer laws all water power which results from the construction of a drain is the property of the district and may be appropriately utilized.

THE PRESENT STATUS OF THE INDIANA DRAINAGE LAW.

A study of the Indiana Drainage laws prior to 1903 is unprofitable except to those who are interested in sheer antiquarianism. The General Assembly of that year adopted a resolution providing for a codification of these laws and the first comprehensive act was passed two years later, in 1905. This performance was repeated in 1907, and since that time the drainage acts have grown steadily in number and confusion. The chief source of this confusion lies in the fact that successive legislatures adopt amendments which have overloaded the statutes with endless verbiage, introduced a multitude of subjects into one section, and seriously impaired their self-consistency. The chaotic condition of the drainage laws in this state finds an unenviable counterpart in the drainage laws of Missouri before their reconstruction in 1909. The laws of that commonwealth proved an inextricable puzzle to laymen, attorneys and contractors and even confounded the Supreme Court itself, the members of which failed to agree as to the meaning of certain important sections. This unfortunate condition created an impasse, frustrated justice and seriously retarded the effective and expeditious execution of the law; and finally the position of the chief tribunal became so embarrassing that members of the court expressed themselves in favor of an immediate and thoroughgoing rearrangement.

This evolution by successive accretion has led in many states to the indefensible method of adopting as many as six separate and distinct systems for accomplishing the same result. It would be as logical and sensible to employ an equal number of systems in the administration of the public schools, the control of corporations or the collection and disbursement of public revenue. The dual system has worked best in practice and is supported with practical unanimity by all drainage and hydrographic experts. One system should provide for the organization of districts by the county courts or boards of county commissioners, and the other for the incorporation of districts by the circuit courts. The selection of the alternative should be left to the voluntary action of the applicants or petitioners. The laws as administered by the boards of county commissioners have usually been found to be more economical and expeditious, but those administered by the courts have obvious and incontestable advantages.

Under the present law, all drainage enterprises, except the construction of dykes and levees, are entrusted to a commission, consisting of the county drainage commissioner appointed biennially by the county board, the county surveyor and a special commissioner selected from the township wherein the drain is located. These commissioners locate and establish all drains and assess benefits and damages. Drains are established on petition of the interested owners, filed with the county commissioners, or with the circuit or superior court if the drain crosses a county line. Any proceeding may be quashed by a remonstrance signed by two-thirds of the persons interested. The work of construction is supervised and the assessments collected by a superintendent of construction appointed by the board. Repairs are made by the township trustee, or the county surveyor on petition of the owners subject to assessment.

SUGGESTIONS FOR LEGISLATION.

In order to perfect an adequate and comprehensive drainage and reclamation plan, this state should adopt a modern, scientific, up-to-date drainage and levee law; it should provide for the appointment of a capable and experienced State Engineer; and it should prohibit the construction of levees and drains in any part of the state which do not coördinate with and form an integral part of a carefully perfected plan.

1. A New Drainage Law. In order to secure a satisfactory and practicable drainage act, this state should adopt the so-called Model Drainage Law which is described in detail elsewhere in this Bulletin. This law was drafted by a corps of competent engineers, it was endorsed by the National Drainage Congress, recommended by the Department of Agriculture, and is being rapidly adopted by all the important swamp land states of the Mississippi valley and the South. It is simple, workable and easily understood, and all dilatory restrictions have been eliminated. Its constitutionality has been invariably upheld. It is equally applicable to the construction of drains or levees and to large as well as to small enterprises. The approved features of the present drainage law should be incorporated with and preserved as a part of the new statute. The adoption of a standardized drainage law will vigorously promote coöperation among the states.

2. A State Engineer. In a second statute, the State should provide for the appointment of an engineer who should be a capable and experienced topographer and skilled in the science of road building. The functions and duties of a State Highway Commissioner and a State Drainage Engineer could be discharged by the same officer, who would be the central disbursing agency for all moneys derived from

the appropriations for post roads and the redemption of waste lands, now under contemplation by Congress. Without a duly authorized receiving and disbursing agency, the state will be excluded from this important source of revenue. In his capacity as State Drainage Engineer, this officer and his assistants, should be required to make a comprehensive topographical survey of the state. The order in which the surveys are undertaken should be left to the discretion of the State Engineer and made to depend on certain practical contingencies such as the expediency and feasibility of the contemplated project, whether the community has taken the necessary steps to organize a drainage district, or whether there is an immediate necessity for the survey. In this way the water-shed of the Kankakee or the Wabash or any other intrastate stream could be surveyed and mapped as a single unified project. The territory comprising the water-shed could then be divided into districts susceptible of adequate drainage or reclamation by a single system of drains or levees, and a plan with appropriate specifications worked out and preserved for each district. As rapidly as drainage associations were formed for the reclamation of these independent districts, accurate scientific data would be available, and the separate units could be developed at any time and in any portion of the territory, but always in accordance with the plans of the general drainage system of which it would form a part, and when finally completed the main drains and the tributary drains would be adjusted to each other, overlapping and duplication would be avoided, and the outlet would always be adequate for each added increment of water. The engineer should also be required to furnish accurate scientific data to any county or drainage association applying for the information and no county or drainage district should be permitted to undertake a drainage or reclamation enterprise until the plans were inspected and approved by the State Engineer.

3. Flood Control and River Improvement.—In perfecting and executing plans for drainage, reclamation, flood con-

trol and river improvement, when indispensable to the conservation of the public health and safety or conducive to the public welfare, and when the project is of sufficient magnitude and importance to warrant the interference of the state, the Drainage Engineer should be authorized to proceed on his own motion or on petition of any county, city, town, village or land owner to create improvement districts, appropriate property for temporary or perpetual use under and by virtue of the principles of excess condemnation, to assess and distribute adequate benefits and to provide for the upkeep, betterment, extension or maintenance under the supervision of the state.

4. DRAINAGE AND THE PUBLIC HEALTH. The State Board of Health on its own motion or on petition of any city, town, village, county, township or resident landowner should be authorized to ascertain whether the drainage of any tract of swamp land is necessary for sanitary purposes. If they determine affirmatively the County Commissioners should be required to make the necessary surveys and specifications and perfect plans, and when these plans are approved by the State Drainage Engineer, the Commissioners should be required to proceed with the construction. If the cost of the construction or betterment cannot be reasonably borne by the interested landowners, the excess should be charged to the county and paid out of the general revenue.

5. CO-OPERATION WITH EXPERTS. The State Drainage Engineer should be authorized to coöperate with the proper departments of the United States Government and enlist their aid in the promotion of drainage enterprises. He should likewise be required to coöperate with the proper departments of the higher institutions of learning in the state as well as the State Geologist in preparing plans and specifications and ascertaining the probable value of soils when drained.

6. OWNERSHIP OF MACHINERY. Drainage districts should be empowered, on petition of a majority of the interested

owners, to purchase and maintain dredge boats for constructing and repairing ditches.

7. Water Power. Provision should be made for the construction of reservoirs and the impounding of water, and all water power accruing therefrom should be the property of the drainage district, municipality or state.

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Pam.

FLOOD PROTECTION IN INDIANA

BY

W. K. HATT
Professor of Civil Engineering
Purdue University

Indiana
Bureau of Legislative Information
Bulletin No. 4

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December, 1914
INDIANAPOLIS

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No. 4. Hints on Bill Drafting.......................1910
No. 5. Digest of the Laws of Indiana of Special Application to Women and Children...........1912
No. 6. Inheritance Taxation 1912

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Bulletin No. 4

December, 1914

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WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING
1914

Indiana Bureau of Legislative Information

State House, Indianapolis

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INTRODUCTION.

Organized effort to study the causes and to lessen the effect of floods in Indiana began with the appointment of the Indiana flood commission by Governor Ralston on April 20, 1914.

This Commission is composed of one member from each congressional district and the personnel is as follows:

Mr. E. W. Shirk, Peru, Chairman.
Professor W. K. Hatt, Purdue University, Lafayette, Chief Engineer.
Mr. Frank C. Ball, Muncie.
Mayor Benjamin Bosse, Evansville.
Mr. William Cronin, Terre Haute.
Mr. Stephen B. Fleming, Ft. Wayne.
Mr. J. E. Frederick, Kokomo.
Mr. S. J. Gardner, New Albany.
Mr. Victor M. O'Shaughnessy, Lawrenceburg.
Mr. Joseph C. Schaf, Indianapolis.
Mr. W. N. Showers, Bloomington.
Dr. Chas. K. Stoltz, South Bend.
Mr. Herman Trichler, Brookville.

The Commission met first in Indianapolis, on April 30, 1914.

The purpose of this Commission is to consider the extent of damage due to floods in the State of Indiana, and to report to the Governor what measures should be taken to provide relief in the future.

The Commission expects to issue its detailed report early in 1915. This report will contain a full presentation of the history of floods in Indiana, a summary of the causes of floods, a collection of available data of rainfall, river discharge and topography, a discussion of flood protection works and a discussion of the principles of legislation to provide for flood relief.

This present pamphlet is an abstract of the forthcoming report of the Commission, prepared in non-technical style in order that citizens may inform themselves upon this very important subject.

JOHN A. LAPP.

FLOOD PROTECTION IN INDIANA.

FLOOD OF MARCH, 1913.

The appointment of the Indiana Flood commission was the direct result of the flood of March, 1913, in which 467 lives were lost and over $160,000,000.00 of property destroyed in the United States. The memory of this catastrophe is still fresh in the minds of the people of Indiana, in which State 39 lives were lost, and over $25,000,000.00 of property destroyed.

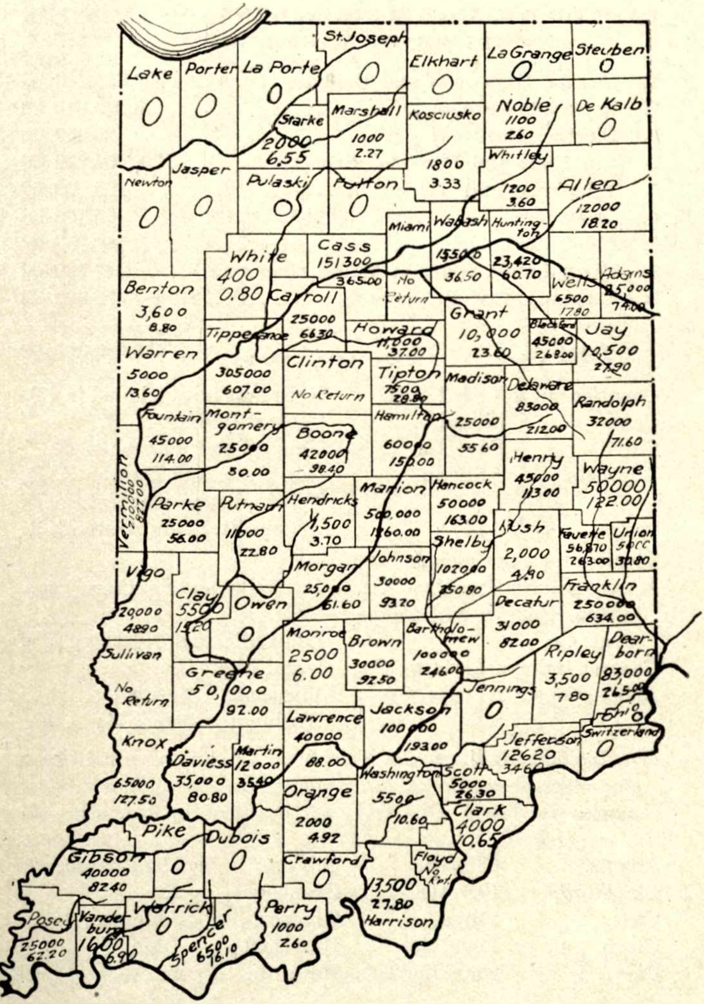
The total loss in the flood of March, 1913, can never be known. The interruption of transportation and of business, the destruction to farm lands by cutting of banks of rivers and covering of bottom lands with gravel, the loss of productive capacity of manufacturing plants, and the sickness following exposure, are not susceptible of exact computation.

Professor Beede of Indiana University reports a total damage of approximately one-half million dollars, in seven counties in the lower White River basin, in which also nearly eight thousand acres of agricultural land were denuded of soil and some sixteen thousand acres of river bottoms were covered with sand and silt. He estimates the loss to agricultural land in this region as nearly $250,000.00.

Part of the damage to country roads and bridges reported by the county auditors was over $3,000,000.00. (See Map 1.) Other tangible losses that have been determined are shown in Table 1. It is probable that other losses during the flood of March, 1913, in Indiana will bring the total losses to more than $25,000,000.00.

Indeed the catastrophe was so general over the Ohio Valley that it excited the sympathy and support of the entire nation. The Governor of the State of Indiana received $141,088.96 in subscriptions for the relief of flood sufferers in this State.

MAP No. 1.



MAP OF INDIANA, SHOWING PART OF DAMAGE TO HIGHWAYS AND HIGHWAY BRIDGES AS ESTIMATED. FLOOD OF MARCH, 1913.

NOTE. Upper figures, total loss; lower figures, loss per square mile.

TABLE No. 1.

PART OF DAMAGES SUSTAINED IN INDIANA IN THE FLOOD OF MARCH, 1913.

1.	County Highways and Bridges	$2,825,240 00
2.	Railroads—Steam	5,299,810 00
3.	Electric Railways	788,000 00
4.	Buildings and Personal Property	8,104,250 00
5.	Telephone and Telegraph	200,000 00
6.	Crops	735,700 00
7.	Live Stock	149,380 00
8.	Farm Lands (part of White river only)	247,500 00
9.	Suspension of Business	582,000 00
	Total	$18,949,390 00

Counties not included in (1)
Cass,
Floyd,
Clinton,
Miami,
Fayette,
Sullivan

Railroads not included in (2)
Central Indiana R R.
Chicago and Wabash R. R.
Cin. Ham. and Dayton R. R.
Toledo, Peoria and Wstn.R.R.
Toledo, St. L. and Wstn. R. R.

Electric lines not included in (3).
Marion and Bluffton Trac. Co.
Bluffton, Geneva and Celina Trac. Co.
Central Indiana Lighting Co.
Indianapolis Street Ry. Co.
Louisville and Southern Trac. Co.
Louisville and Northern Ry. and Light Co.
Vincennes Traction Co.
Washington Street Ry. Co.

(5) Includes Indianapolis Telephone Co. and Central Union Telephone Co.

Counties in Flood Districts not included in (4), (6), (7) and (9).
Adams,
Blackford,
Cass,
Clark,
Clay,
Clinton,
Fayette,
Floyd,
Fountain,
Franklin,
Gibson,
Grant,
Greene,
Harrison,
Howard,
Huntington,
Jay,
Jefferson,
Ohio,
Parke,

Perry,
Putnam,
Randolph,
Ripley,
Scott,
Sullivan,
Switzerland,
Tippecanoe,
Vanderburgh,
Vermillion,
Vigo,
Wabash,
Warrick,
Wells,
White,
Whitley.

(8) Includes loss only in 230 miles of East and West Forks of the White River through Morgan, Owen, Greene, Daviess, Knox, Jackson, Lawrence and Martin Counties.

FORMER FLOODS IN INDIANA.

Floods have occurred in Indiana as far back as records are obtainable. In the early days, before levees had been raised above high water, and before cities had been built in the bottoms, the losses were small, and people did not have to pass over the river until the flood waters subsided.

In recent years the effects of similar floods have become more serious, and the problem has become acute. It has been made so by the inevitable encroachments on the flood plains and bottoms which were formerly given up to the rivers during floods, while at the same time, channels have not been improved in proportion to the encroachment.

The Indianapolis News of September 26, 1914, contains a summary of the report on historic floods in Indiana prepared by the State Librarian, Mr. Demarchus Brown. Mr. Brown's report is of great interest and value, and is summarized for Indiana in Table 2.

This Table shows only severe and widespread floods that occurred in this State. It is seen that the average interval between Indiana floods of great magnitude is six and one-fourth years. The numerical values at Ohio River points indicate the height of the gauge above danger point. The floods on the Ohio River which damaged such cities as Louisville, Jeffersonville, and Evansville, are also included under "Ohio River."

A quotation from the "Lawrenceburg flood report, 1913", will instance the situation in one locality,—

"The records of the Weather bureau show that not a single year of the forty immediately preceding 1913 has

TABLE No. 2— Showing the periodicity of great floods in the Ohio River valley.

	PITTSBURGH F S 220	WHEELING F. S. 360	PARKERSBURG F S 360	MARIETTA F S 350	CINCINNATI F S 500	LOUISVILLE F S 280	EVANSVILLE F S 350	PADUCAH F S 430	CAIRO F S	WABASH	E FK WHITE	W FK WHITE	WHITEWATER	OHIO	MIAMI	SCIOTO
1773					Tradit-ion 28										Mar (Trad'n)	
1789														May Sept		
1805															Jan'y	
1806	Apr 119															
1810	Nov 100													Dec		
1813	Jan 70													Jan		
1815														Spring		
1816	Feb 110															
1826														Mar		
1828															Feb'y	
1832	Feb 130		Feb 135		Feb 143	Feb 128	Feb 113							Feb'y	Feb'y	
1840																
1846														Mar		
1847					Dec 156					Jan'y	Jan'y	Jan'y	Jan'y		Jan'y	
1851	Sept 89															
1852	Apr 99															
1857										June						
1858											Apr	Apr		Apr		
1859					Feb 55											
1860	Apr 77															
1861	Sept 90															
1862	Jan 80				Jan 73											
1862	Apr 59															
1865	Mar 94				Mar 63											Sept
1866										Sept	Sept	Sept	Sept	Sept	Sept	
1867					Mar 58			Mar 90								
1870					Jan 53											Jan
1873																
1874								Apr 57								
1875							Aug 69			Aug				Aug		
1876							Jan 85									

NOTE: The decimal points have not been reproduced in all cases in this cut.

	PITTSBURGH	WHEELING	PARKERSBURG	MARIETTA	CINCINNATI	LOUISVILLE	EVANSVILLE	PADUCAH	CAIRO	WABASH	E FK WHITE	W FK WHITE	WHITEWATER	OHIO	MIAMI	SCIOTO
1877							Jan 6.5									
1881	June [illegible]															
1882					Feb 86	Feb 94	Jan 59 Feb 99	Jan 5.8 Feb 7.0	Feb 69					Feb		
1883	Feb [illegible]		Feb 92	Feb 8.1	Feb 16.3	Feb 16.4	Feb 128	Feb 77	Feb 72	Feb				Feb	Feb	Feb
1884	Feb 113	Feb 71	Feb 78	Feb 178	Feb 211	Feb 185	Feb 138	Feb 112	Feb 6.8	Feb				Feb		
1886					Apr 58		Apr 84	Apr 74								
1887					Feb 63		Feb 87 Mar 81									
1890					Mar 68	Mar 6.1	Mar 89	Mar 55								
1890					Mar 92	Mar 9.5	Mar 94									
1891	Feb 93	Feb 89	Feb 86	Feb 88	Feb 73		Mar 78									
1893							Mar 68 May 53									
1897	Feb 75				Feb 11.2	Feb 74	Mar 86	Feb 79	Mar 66	Mar	Mar	Mar	Mar		Mar	
1898	Mar 79	Mar 82	Mar 11.8	Mar 125	Mar 114	Mar 83	Jan 81 Apr 98								Mar	Mar
1899					Mar 74		Mch 77 Apr 54									
1900	Nov 67															
1901	Apr 55			Apr 64	Apr 97		Apr 68									
1902	Mar 104	Mar 60					Mar 50									
1902							Dec 50									
1903	Mar 69						Feb 57 Mar 74		Mar 56							
1904	Jan 80	Jan 79		Jan 58						Mar	Mar	Mar	Mar	Mar		
1905	Mar 70	Mar 63	Mar 64	Mar 5.4												
1906							Apr 61									
1907	Mar 155	Mar 141	Mar 156	Mar 137	Jan 152 Mar 121	Jan 134 Mar 80	Jan 112 Mar 88		Jan 5.4	Jan	Jan		Jan	Jan		
1908	Feb 87 Mar 53	Feb 66	Feb 52		Ap 59		Feb 59 Mar 65 Apr 72			Mar May	May	Mar May		May		
1909						Feb 50	Mar 8.2									
1910										Oct	Oct	Oct	Oct	Oct		
1912	Mar 61						Mar 76	Apr 69	Apr 90							
1913	Jan 93 Mar 84	Jan 82 Mar 151	Jan 91 Mar 233	Jan 76 Mar 198	Jan 127 Mar 20.8	Jan 115 Mar 163	Jan 117 Mar 133	Jan Mar 113	Mar 98	Jan Mar	Jan Mar	Jan Mar	Jan Mar	Jan Mar	Jan Mar	Jan Mar

From Weather Bureau ~ Bull. Z and U.S.G.S.~W.S. Paper-334

From Newspaper Accounts

been free from devastating floods in some part of the Ohio Valley. * * * The historic floods in the Cincinnati district and the territory contiguous thereto were in the years 1773, 1832, 1847, 1883, 1884, 1897, 1898, 1907, and 1913. In every one of these floods the crest of the rise exceeded sixty feet on the Cincinnati gauge. The danger line at Cincinnati is fixed at fifty feet. Thirty-five times since 1832 has the water at Cincinnati passed the fifty-foot mark. Seventy-seven times since 1832 has it passed the danger line at Pittsburg, twenty-eight times at Wheeling, twenty-five times at Marietta since 1873, eighty-six times at Evansville, and twenty-eight times at Paducah. There is, therefore, a constant menace to life and property along the Ohio River and its tributaries. * * * In this danger zone Lawrenceburg, Indiana, is peculiarly situated. * * * The mean level of the city, therefore, is approximately eleven feet below the crest of the highest flood of which we have definite knowledge, and ten feet below that of April, 1913. Perhaps four-fifths of the city lies below the line of sixty feet and, consequently, would have been flooded no fewer than a dozen times in the last half century had there been no artificial barrier. Four times within thirty-two years has the artificial barrier been swept away and the city completely inundated. These unfortunate occurrences were in 1882, 1883, 1884, and 1913."

Cities like Indianapolis, Fort Wayne, Peru, Logansport and Brookville are also in peril from future floods.

CHARACTERISTICS OF FLOODS.

Table 2 shows that serious floods may occur at any time throughout the year, but they usually happen between December and April. January, February, and March are the months when the combination of rainfall and surface conditions produce the worst effects.

Characteristics of Storms Preceding Floods.

January 1847—Rainfall.
June 1857—
September 1866—Series of heavy thunderstorms.
August 1875—Heavy rains following wet summer.
February 1883—High monthly precipitation with thaw.
March 1897—Series of excessive rains.

March 1904—Series of storms.
February 1908—Moderate rain with thaw.
October 1910—Single protracted storm.
January 1913—Single protracted storm.
March 1913—Two protracted storms, practically one.

A heavy storm, shedding long continued rain, sweeps up the Ohio Valley, and finds the ground frozen or covered with snow, the subsoil saturated and the channels already charged with water, so that the greater part of this rainfall runs off through the streams.

The tributaries may all be discharging and attempting to find outlet at the same time, through the main channel, in which people have been dumping refuse, constructing levees and buildings that add to the height of flood waters.

The meteorological conditions attending serious floods are made clear in Diagrams 1 to 4. A storm starts in the southwest and follows up a trough of low pressure between two high pressure areas on either side of the Ohio Valley. Sometimes a second storm follows up the first immediately, and it is a further burden upon the overtaxed channels. (See Diagram 1.)

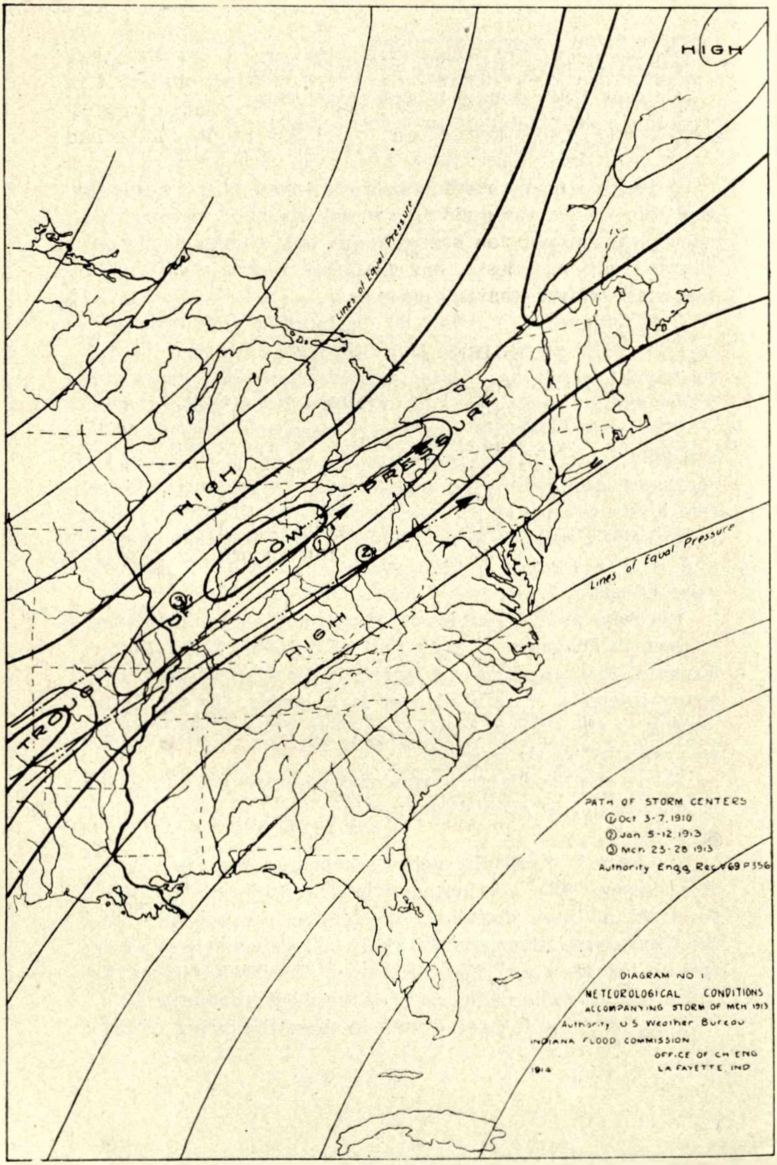
Records are available of three notable past storms. (shown in Diagrams 2 to 4) that of October, 1910; that of January, 1913; and that of March, 1913; characterized by a heavy intensity of rainfall over large areas, the two latter coming at the time of year when very little of the rainfall was absorbed in the ground.

As we shall see later, storms such as these are a measure of the amount of river discharge that flood protecton works must carry.

Diagram 1 shows the paths taken by these three excessive storms. The northern portions of Indiana lie outside the track of these storms. For example, the Eel River and the Tippecanoe River are not likely to receive as heavy rainfall as the East and West Forks of the White River, because the latter lie in the path of these severe storms.

Diagrams 5 and 6 are drawn to show the inches of rain-

DIAGRAM No. 1.


HIGH
Lines of Equal Pressure
HIGH
TROUGH OF LOW PRESSURE
① ② ③
HIGH
Lines of Equal Pressure
PATH OF STORM CENTERS
① Oct 3-7, 1910
② Jan 5-12, 1913
③ Mch 23-28 1913
Authority Engg Rec V69 P356
DIAGRAM NO 1
METEOROLOGICAL CONDITIONS
ACCOMPANYING STORM OF MCH 1913
Authority U S Weather Bureau
INDIANA FLOOD COMMISSION
OFFICE OF CH ENG
LA FAYETTE, IND
1914

fall that fell at various localities affected by the storm. It is plain that large areas receive a less average rainfall than small areas. For instance, in Diagram 5, we find that in January, 1913, an area of 500 square miles had a rainfall in excess of eleven inches; an area of 2,500 square miles had a rainfall in excess of ten inches; and an area of 14,500 square miles had a rainfall in excess of eight inches. From a study of the three storms, Diagram 7 has been prepared to show the relation between an area of given size in a watershed, that lies in the path of these storms, and the amount of rain that may reasonably be expected on this area.

POSSIBLE FUTURE STORMS.

The storm of March, 1913, was not as heavy as either that of January, 1913, or that of October, 1910. Of course a combination of the storm of January and a snow-covered surface is possible, and would have caused a flood greatly in excess of that of March. It is fortunate that these storms sweep up, instead of down, the Ohio Valley, because the latter storm would tax the channel more severely than the former.

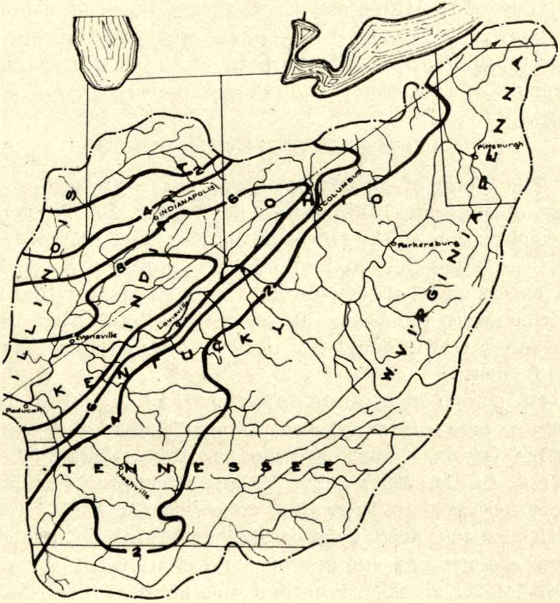
Of course, small areas in any part of the State may receive a heavy local rainfall, at any time of the year, and bridge openings must provide for this rainfall. For instance, in the Muskingum Valley an unprecedented rainstorm occurred in July, 1913, following the flood of March, 1913, causing flood heights higher than those of the previous storms. At one station a rainfall of 7.17 inches was recorded for a period less than nine hours.

But we are now speaking of storms that cause widespread floods over an entire watershed, and trying to estimate what rainfall we should provide for in improved channels and under bridges in plans for flood protection works.

A simple method is to specify that these works shall carry the rainfall of March, 1913, that caused the greatest flood on record, and then add to this an arbitrary increase of one-third in the White River and a less amount in the more northerly watersheds further removed from the path of extraordinary storms.

Diagram 6 shows (Lines a) the actual rainfall that occurred in the Wabash Valley and the two forks of the White River in March, 1913, and also (Lines b) the rainfall that would have fallen if the March storm had been increased by a factor of one-third on the White River, and a factor of one-fourth on the Wabash River. This increased rainfall on the East Fork of the White River and

DIAGRAM No. 2.



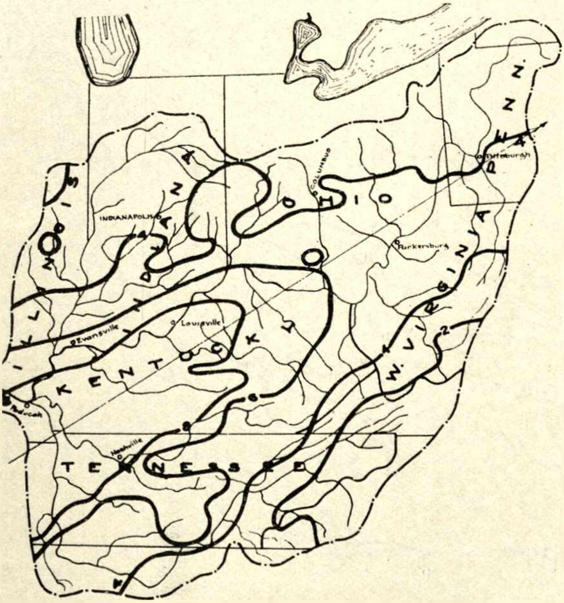
OHIO RIVER WATERSHED.

TOTAL PRECIPITATION OCTOBER 3-6, 1910.

the lower Wabash River is nearly the same as that which would have occurred if the storm of January, 1913, had followed a path 75 miles farther north.

Of course if such a storm as that of October, 1910, were arbitrarily shifted to a path over the headwaters of the Wabash, extraordinary conditions would be found. As a matter of fact, however, the centers of these storms causing severe floods in Indiana do not pass this far north. It would be unreasonable to predict a rainfall intensity in northern Indiana and impose a factor of safety against future contingencies, as high as equal areas receive in the White River Valley.

DIAGRAM No. 3.

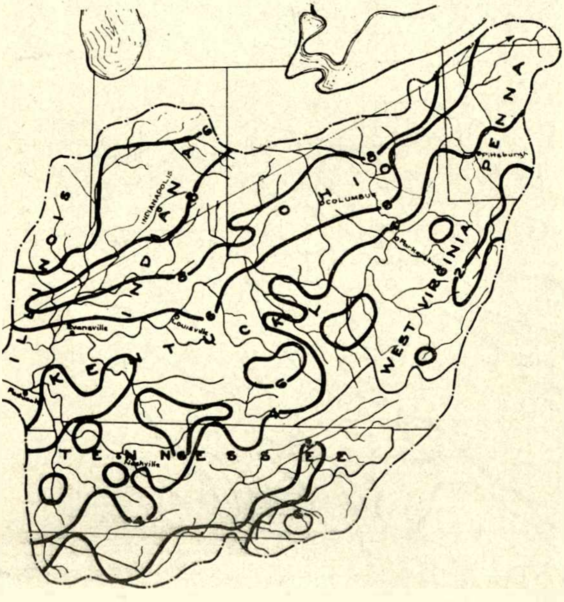


OHIO RIVER WATERSHED
TOTAL PRECIPITATION JANUARY 1–13, 1913.

CONCLUSION AS TO RAINFALL.

In general then, we may reasonably require that the constructions for flood protection works on the Wabash and the White Rivers should provide for the rainfall shown by the lines in Diagram 7.

DIAGRAM No. 4.

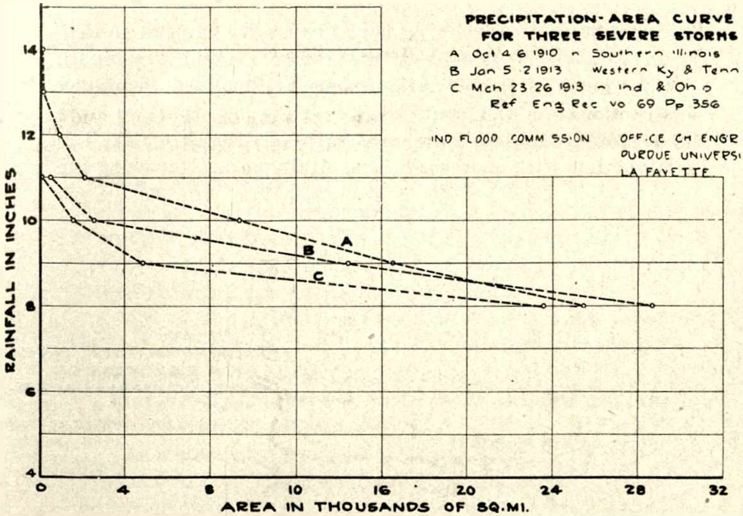


OHIO RIVER WATERSHED.
TOTAL PRECIPITATION MARCH 23-27, 1913.

PERIODICITY OF RAINFALL.

A curious relation between the amounts of rainfall through cycles of years is evident from Diagram 8 which shows the distribution of yearly rainfall since 1830. The

DIAGRAM NO 5



PRECIPITATION-AREA CURVE FOR THREE SEVERE STORMS

A Oct 4 6 1910 in Southern Illinois
B Jan 5 2 1913 Western Ky & Tenn
C Mch 23 26 1913 in Ind & Ohio
Ref Eng Rec vol 69 pp 356

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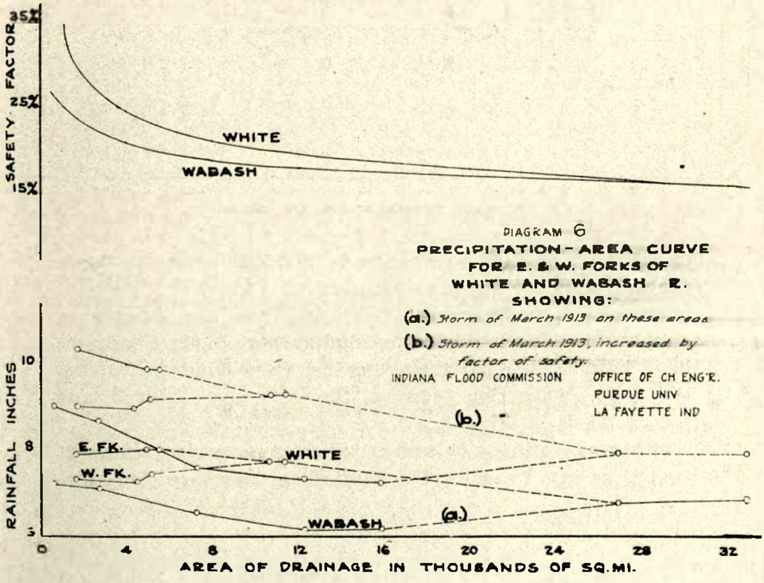

DIAGRAM 6

PRECIPITATION-AREA CURVE FOR E. & W. FORKS OF WHITE AND WABASH R. SHOWING:

(a.) *Storm of March 1913 on these areas*

(b.) *Storm of March 1913, increased by factor of safety.*

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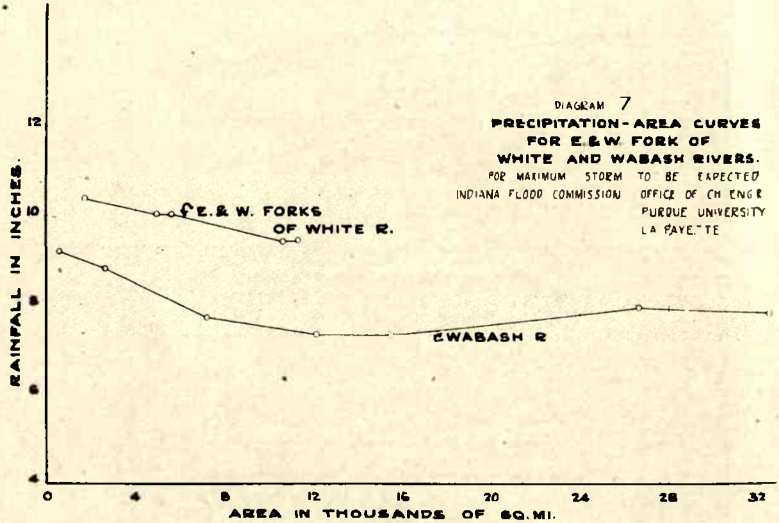
cycle of 34 years from a period of excessive rainfall to deficient rainfall is evident in the region around Cincinnati. On the basis of this Diagram, some are inclined to predict heavy floods in the near future. They say that we have been passing through a series of years of deficient rainfall in conjunction with increased farm drainage and growing encroachments upon stream channels, and that excessive floods are indicated for the near future.

DIAGRAM No. 7.



Inasmuch as the great floods occur in the months of January to March, inclusive, similar periodicity Diagrams have been drawn for these months, (See Diagram 9) and the close connection between the excessive rainfall and severe floods is evident.

These Diagrams (8 and 9) show progressive averages, that is to say, to obtain the rainfall for any year, the rainfall of the previous year and succeeding year are averaged along with the rainfall of the year in question. The latter is given double the weight of the others in this average.

RAINFALL AND STREAM DISCHARGE.

How much of this rainfall will discharge in the rivers? Only a part of the rain that falls on the upper reaches of a watershed ordinarily runs by a city below. Great floods occur when the greater part of the rainfall runs off in the streams during the extraordinary storms.

Part of the rainfall is held back for a time in porous subsoil, in swamps, and in the ground surface, especially in forest cover, and is let out gradually.

Part of the water also disappears through evaporation and is used by vegetation.

For instance, in the former days before land was drained for agriculture, the heavy rains of the winter and spring were held back in the swamps and other natural detaining agencies, until near mid-summer.

"In the early days our country farmers in the down-stream part of the valley, as well as the up-stream part, plowed just the land which was readily tillable without artificial aid. Then, as population increased, land which needed artificial aid for cultivation was occupied. In the northern part of Illinois, where I was born and raised, I can remember distinctly the number of small swamps, the number of little pockets in cultivated fields where the water used to lie into the middle of the summer. But year after year our farmers have been putting down tile drains. They formed drainage districts and have cut ditches until now nearly the entire northeastern part of Illinois is drained dry almost immediately after a rainstorm in warm weather, or as soon as the snow is melted after the winter. The result is recognized even in our larger streams like the Des Plaines River and the Fox River. In the early days they tell us the water power from those streams was nearly permanent the year round. Now the water power has practically disappeared. We have high water for a month or two, and then historical remnants of the stream for the summer. These swamps used to act as regulators. The

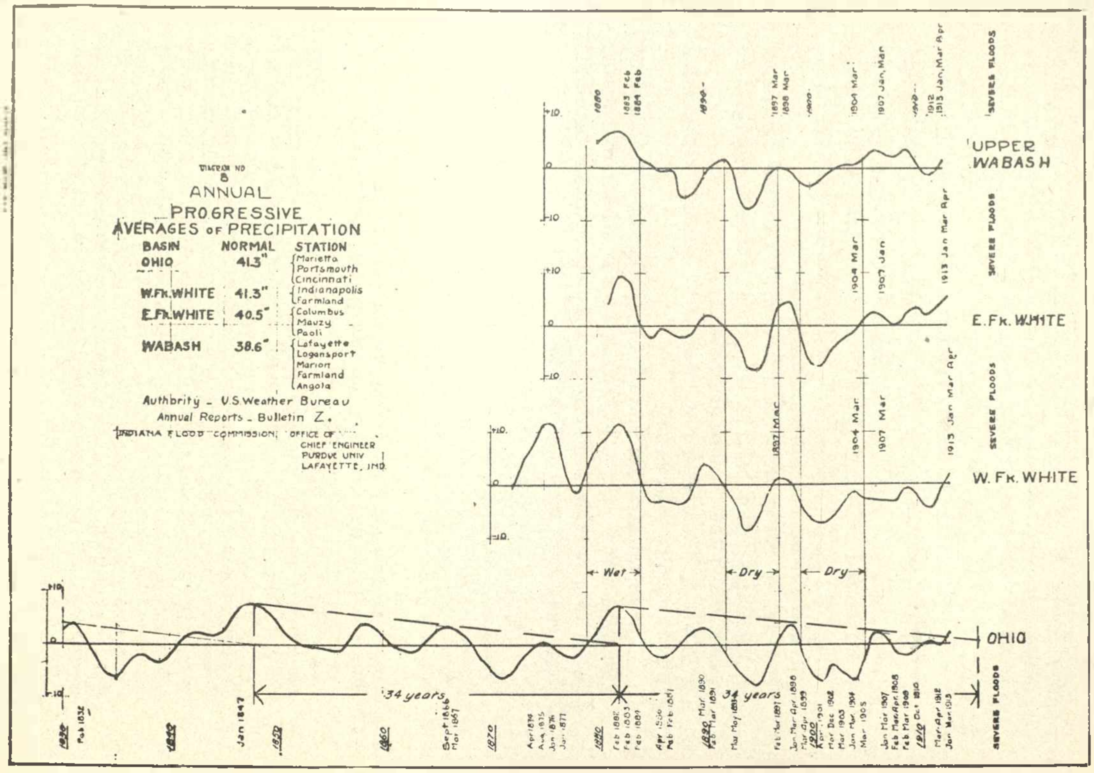


DIAGRAM No. 8.

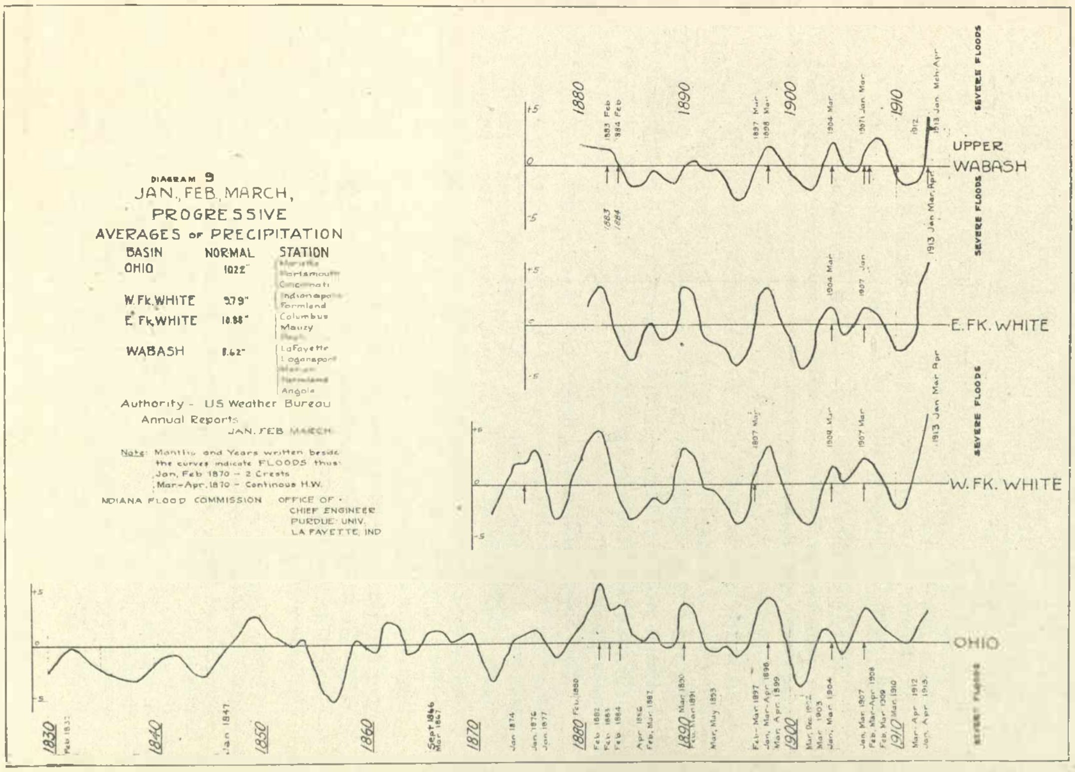


DIAGRAM No. 9.

high water of the spring would go into these bottom lands which were more or less in the form of rice marshes and fill them up with a raise of ten or twelve feet, and then as the river sank these bottom lands would discharge and help regulate the flow during the summer. Enterprising men have bought these lands and have put levees across on the river side with pumping machinery to pump out the water which fills in there, and they no longer serve to regulate the stream."—Robert McCormick in Bulletin No. 8, Rivers and Lakes Commission, State of Illinois.

There was then higher water in the streams throughout the summer than at present, and the ordinary workings of the river were more even.

There is no doubt but that, because of the cutting down of the forests and the draining of the swamps, and the construction of large drainage systems for farm lands, the rain now runs more rapidly to the watercourses, and the height between ordinary high and low water is greater. These new conditions must cause more frequent floodings of our river bottoms.

But these tremendous floods like March, 1913, are due to severe storms that send rain down upon the surface when the soil is already as full as a wet sponge, or frozen, or when there is snow on the ground. Even if the swamps and forests were in existence, they would have had no further capacity left to take this heavy rainfall. It would have run quickly into the streams as it does now.

Then too, in early times, the bottoms of the rivers were grown up in thick forests which offered great resistance to the free flow of flood waters over the bottoms outside of the river channel.

"The character of the Valley Lands of the Illinois River, as described in official reports, is shown by the following excerpts: Howard Stansbury, 1838—(U. S. Topographical Engineer) 'The bottom lands extend from one to five miles on each side of the river, seldom rising more than a few feet above the level of the stream in its ordinary stages, and from the fact that they are constantly overflowed, by every freshet, to a depth varying from one to fifteen feet, are now and must ever remain uninhabited.

Hence the river presents the appearance of flowing through an ancient, vast and solitary forest, clothed with a foliage rich and luxuriant beyond description, where solemn silence has never been broken, save by the howl of the panther, or the still more savage yell of the redman.' "—Quoted in "The Illinois River, Physical Relations and the Removal of the Navigation Dams." The Sanitary District of Chicago.—By Lyman E. Cooley.

Those who have given close study to the matter are not able to find evidence that the flood heights during these extreme floods are higher than flood heights in early days, except in the cities and other localities where the embankments, levees, buildings and bridges have made local obstructions that dam up the waters, and create a head of back water.

One serious problem in Indiana at present is the control of future obstructions to the free flow of flood water in our streams, and to remove present obstructions that will interfere with the building of flood protection works by our cities.

DETERMINATION OF RIVER DISCHARGE.

The part of the rainfall that runs off into the streams, that is, the "runoff", is expressed as river discharge. The shape of the watershed whether long and narrow, or short and wide, and the character of the surface, whether rocky or with deep gravel sub-soil, and the convergence of the side tributaries and the steepness of the watershed, each has its own particular effect on the rate at which the runoff reaches the river channel.

A long narrow watershed will not deliver rainfall as quickly to a point in the channel below as will a short and compact watershed.

The difficult problem is to compute the river discharge at any city arising from the rainfall on the watershed above.

Certain formulas have been proposed by which the river discharge may be computed. For instance, Mr. W. E. Fuller's formula, (Proc. Am. Soc. Civil Eng., Vol. 39, P. 1012) is

$$Q = CA^{0.8}$$

where Q is the average yearly flood, in cubic feet per second; C is the coefficient which is constant for the river at the point of observation; A is the catchment area of river in square miles.

Mr. Fuller remarks that the largest flood occurring in one hundred years will be 2.6 times the average yearly flood. This subject is now under lively discussion by engineers and other formulas are proposed, but all of these must depend upon the measurements of river discharge, which are lacking for conditions in Indiana.

The only certain method is to actually measure, by well known methods and tried instruments, the discharge of our rivers through a long term of years. Many States have done this in co-operation with the United States Geological Survey. Then the engineer will know the number of cubic feet per second of river-discharge for which flood protection works must be designed.

But we have made so little progress in scientific study of our streams that we are seriously handicapped in studies for flood protection.

Certainly one important effort that the State of Indiana must exert in the future is to provide for these streams gagings through a co-operative agreement with the United States Geological Survey, which has trained men and the instrumental equipment to perform this work efficiently.

These stream gagings would, however, require a long term of years for their completion.

Meanwhile many of our cities are in increasing danger from floods. In some cities the situation is acute and the people can not wait for a complete determination of scientific data before planning flood protection works.

For immediate purposes and in the absence of full information, the following method of solving the problem will be found useful and reasonably satisfactory.

Briefly, the method consists in finding the river discharge at selected points, the rainfall in the valleys above these points during the flood conditions of March, 1913, the general slope of the drainage area, and then to apply these measurements to watersheds of like character.

Diagram 10 shows our best information of river discharge in March, 1913. The number of cubic feet per second flowing from a square mile of watershed is shown in dashed line. These all had different slopes of watershed. In full line the measurements have been adjusted to a standard rainfall of seven inches, and to a standard average slope of watershed of 2 feet per mile.

The full line may be used with a reasonable degree of certainty to predict river discharge for the White River and the Wabash River watersheds in Indiana, after making allowance for the expected rain fall and the slope of the watershed.

For example, the area of the White River watershed above Indianapolis is 1680 square miles, for which area Diagram 10 provides a discharge of 39.5 cubic feet per second per square mile, (that is for a rainfall of seven inches and a standard slope of the drainage area of two feet per mile). But the expected rainfall for 1680 square miles is (Diagram 7) 10.35 inches. The fall from the rim of the watershed to Indianapolis is 450 feet in a length of 83.5 miles, and therefore the average slope of the bed of the drainage area is 5.40 feet per mile on an average.*

To find what river discharge Indianapolis may reasonably expect to pass through its flood protection works, we must increase the rate of discharge of 39.5 cubic feet per second per square mile, above mentioned, in proportion to the probable rainfall and also increase it as the fourth root of the slope. Our computation is then as follows:

$$39.5\times\frac{10.35}{7}\times\sqrt[4]{\frac{5.40}{2}}\times 1680=125{,}580 \text{ cubic feet per second.}$$

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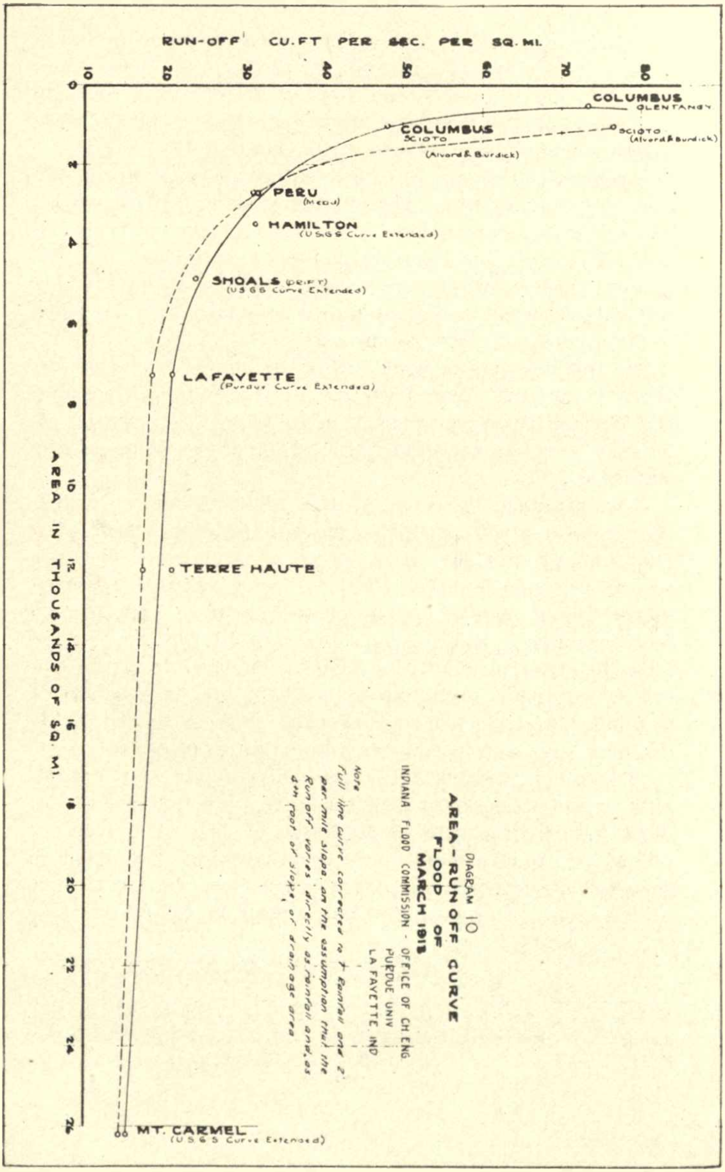
*The slope of the river channel is less than the slope of the drainage area. For the White River above Indianapolis the average channel slope is 3.41 feet per mile.

DIAGRAM No. 10.



OPENINGS REQUIRED TO CARRY RIVER DISCHARGE.

The civil engineer is able to calculate the size of channel and the length of bridge opening to carry the river discharge. He must take into account local conditions, including the slope of the river bed, the alignment of the channel, whether straight or crooked, and the character of the material in the river bed. A steep slope with rock river-bed will permit a small channel where high velocities will not interfere with navigation.

It is impracticable to draw general rules to fit these local conditions in advance. As a rough estimate it may be stated that the velocities in improved river channels should not exceed six feet per second average velocity, and through bridge openings should not exceed eight feet per second.

For instance in the case of Indianapolis, there is indicated on this basis an area of channel of $\frac{125,580}{6} = 20,930$ square feet, and openings through bridges of 15,700 square feet. In this case the local conditions of the streams should be studied to see if such velocities can be obtained under the hydraulic characteristics of the channel.

The Indiana Flood commission is making a special study of bridge openings in this state, and is collecting statistics showing the bridge openings in our important streams and noting whether or not they were damaged in the flood of March, 1913. This study will not only serve to determine the measure of protection of these structures, against floods, but will serve as a basis for rules to determine the proper size of bridge openings in the future.

NEED OF SURVEYS.

We are also handicapped in studying floods in Indiana by the lack of topographic surveys, which show the contour of the surface of the State. These maps are not only useful and necessary for studying flood prevention, but serve a variety of other purposes as follows:

1. As preliminary maps for planning extensive irrigation and drainage projects, showing areas of catchment for water supply, sites for reservoirs, routes of canals, etc.
2. For laying out highways, electric roads, railroads, aqueducts, and sewerage systems, thus saving the cost of preliminary surveys.
3. In improving rivers and smaller waterways.
4. In determining and classifying water resources, both surface and underground.
5. In determining routes, mileage, location of road-building material, and topography in country traversed by public highways.
6. In classifying lands and in plotting the distribution and nature of the soils.
7. As base maps for the plotting of information relating to the geology and mineral resources of the country.

The State of Ohio has completed 87% of its survey, while Indiana has only 9% completed. See Map No. 4.

Certainly the State should enter upon this survey at an early day. It is estimated that by an appropriation of $50,000.00 annually for five years, this survey could be completed, under a co-operative agreement by which the United States Geological Survey would meet the remaining half of the cost.

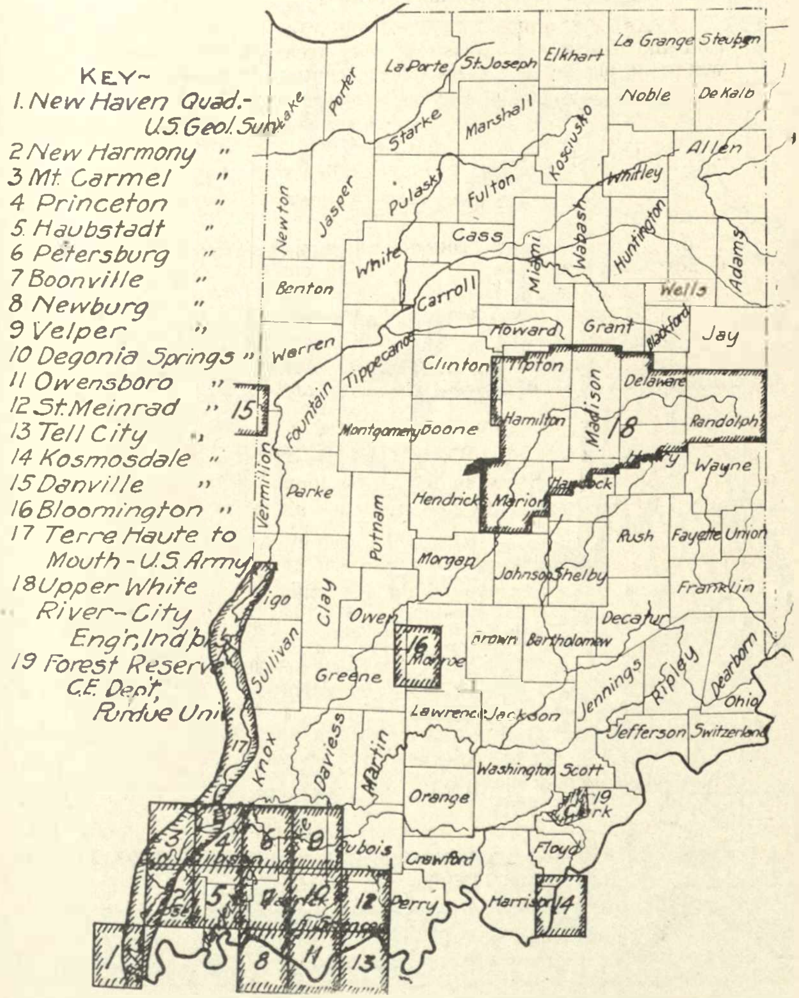
METHODS OF FLOOD PREVENTION AND PROTECTION.

In what ways may the flood waters be checked? Or if these flood waters reach our cities, how may the protection works be constructed?

Reservoir Control.

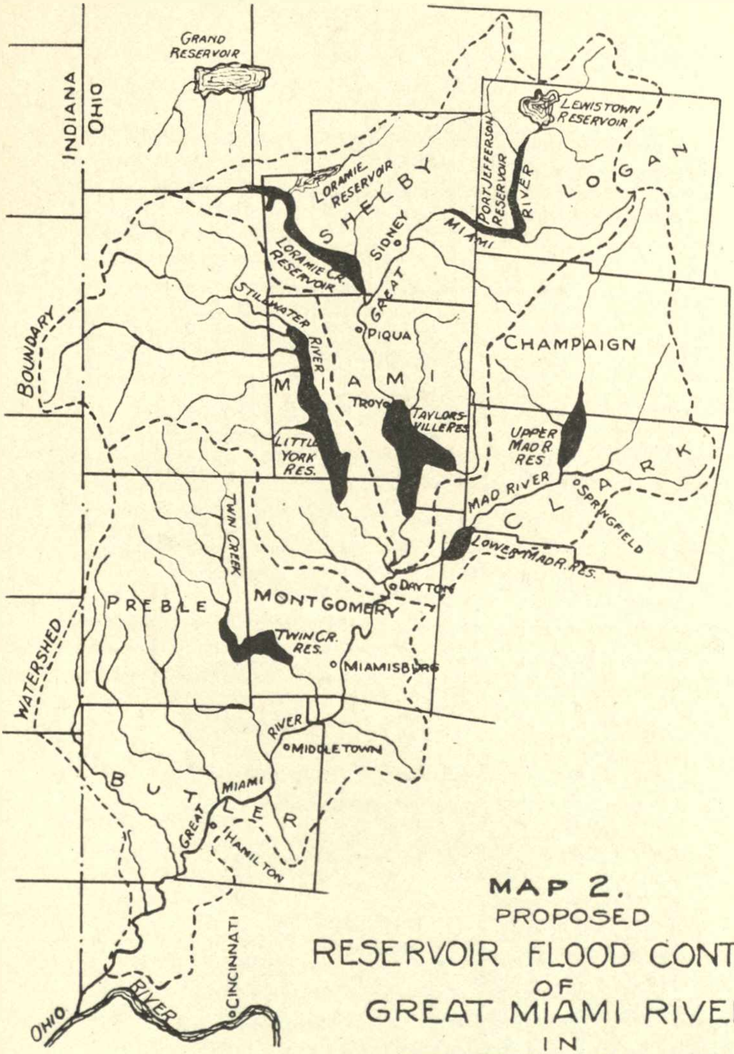
While we can not prevent the rain from falling, we can in some cases detain it in reservoirs placed in the upper watersheds for a time, and let it out gradually in the channels and thus diminish flood heights below.

MAP No. 4.



AREAS SURVEYED IN STATE OF INDIANA.

MAP No. 2



MAP 2.
PROPOSED
RESERVOIR FLOOD CONTROL
OF
GREAT MIAMI RIVER
IN
STATE OF OHIO
SCALE

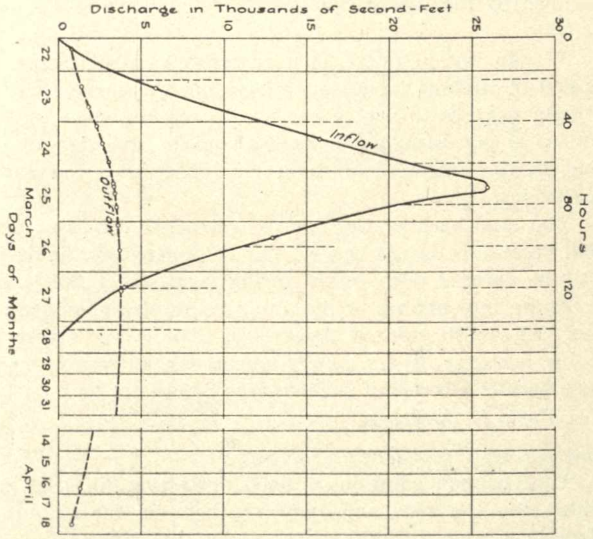
AUTHORITY~
ENG. RECORD
MAR. 28, 1914

INDIANA FLOOD COMMISSION
OFFICE OF CHIEF ENG'R.
PURDUE UNIVERSITY
LAFAYETTE, IND.

Such flood control by detention reservoirs has been used in Europe and is planned for the Great Miami River in Ohio. See Map 2.

The flood waters in the upper Miami are to be collected in impeding or detention reservoirs, shown in black locations on the map. These are not storage reservoirs, but they discharge automatically through channels always open, through the bottom of the dams. These channels are so proportioned that the greatest flow through them will not exceed the carrying capacity of the stream below. See Diagram 11. In the case of the Miami Valley, it was found

DIAGRAM No. 11.



EFFECT OF PROPOSED UPPER MAD RIVER RESERVOIR ON STORM OF MARCH, 1913

DIAGRAM NO 11

Run-off 90% of Rainfall

From Eng Rec Vol 69 No 13

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LA FAYETTE, IND

that the entire valley including both cities and farm lands could be protected from flood damage at a cost of $17,000,000.00 by this method of impounding reservoirs. On the other hand, the cost of the separate works that were planned by a number of individual cities along the river, for city protection alone, using the ordinary methods of levees and channel improvements, amounted to over $100,000,000.00.

It is interesting to know that this system was accurately planned by the use of the topographical maps of the State of Ohio.

We do not know if such reservoir control can be obtained in Indiana, because we have not the surveys nor the stream gagings to use in the studies of our streams. The use of such reservoirs depends upon the question of fact, that is, the existence of favorable topography and natural reservoirs.

The land back of the dams constructed for these detention reservoirs is not thrown out of cultivation, and would only be covered with water during very severe floods.

These impounding or detaining reservoirs should not be confused with storage reservoirs. The latter store the water and use it for power purposes and water supply. Incidentally a series of such storage reservoirs may mitigate the effects of floods.

Levees and Channel Improvements.

The common solution of flood protection to cities is to widen the channels and improve them by taking out obstructions, and to build levees along the banks.

Planning levees and channel improvements is the work of the civil engineer. The size and slope of the channel must be properly related to the flood waters, the proper type and height of levees designed, and consideration must be given to the effect of these on sewer systems, and grades of streets. Often bridges must be redesigned.

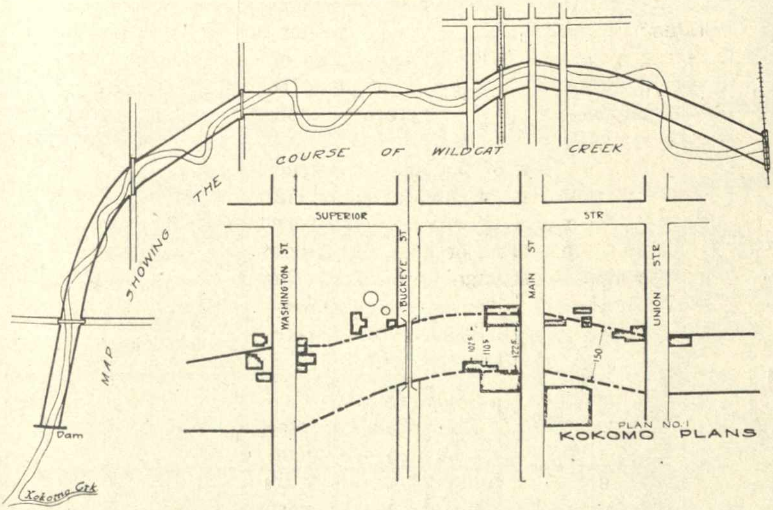
Sometimes the best solution will be found in a cutoff channel. Certain typical plans for levees and channel improvements are shown in Plans 1 to 3.

The following cities in Indiana have been active in flood protection studies and reports: Indianapolis, Fort Wayne, Peru, Kokomo, and Lawrenceburg.

In planning such flood protection works, difficult problems are found in the re-construction of old bridges and in the existence of factory buildings where flood water should be allowed to pass.

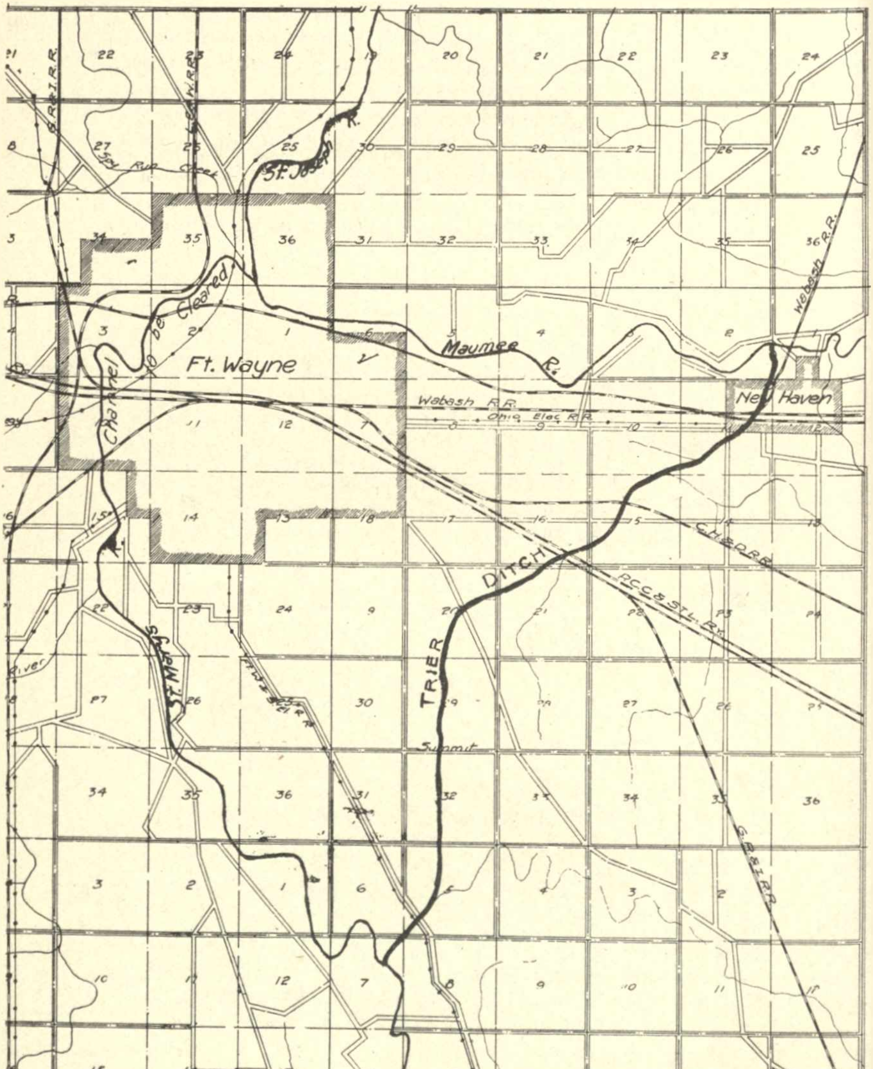
Indeed a large problem presents itself in deciding the best public policy with respect to the proper use of the flood plain of our rivers, as distinct from the channel. In modern cities it seems unreasonable to give up to the river its complete flood plain, as in the state of nature. However, the river will certainly demand a portion of it and this portion should be laid out in parks or devoted to other uses in which an occasional flood will not result in a loss of life or a great loss of property.

PLAN No. 1.



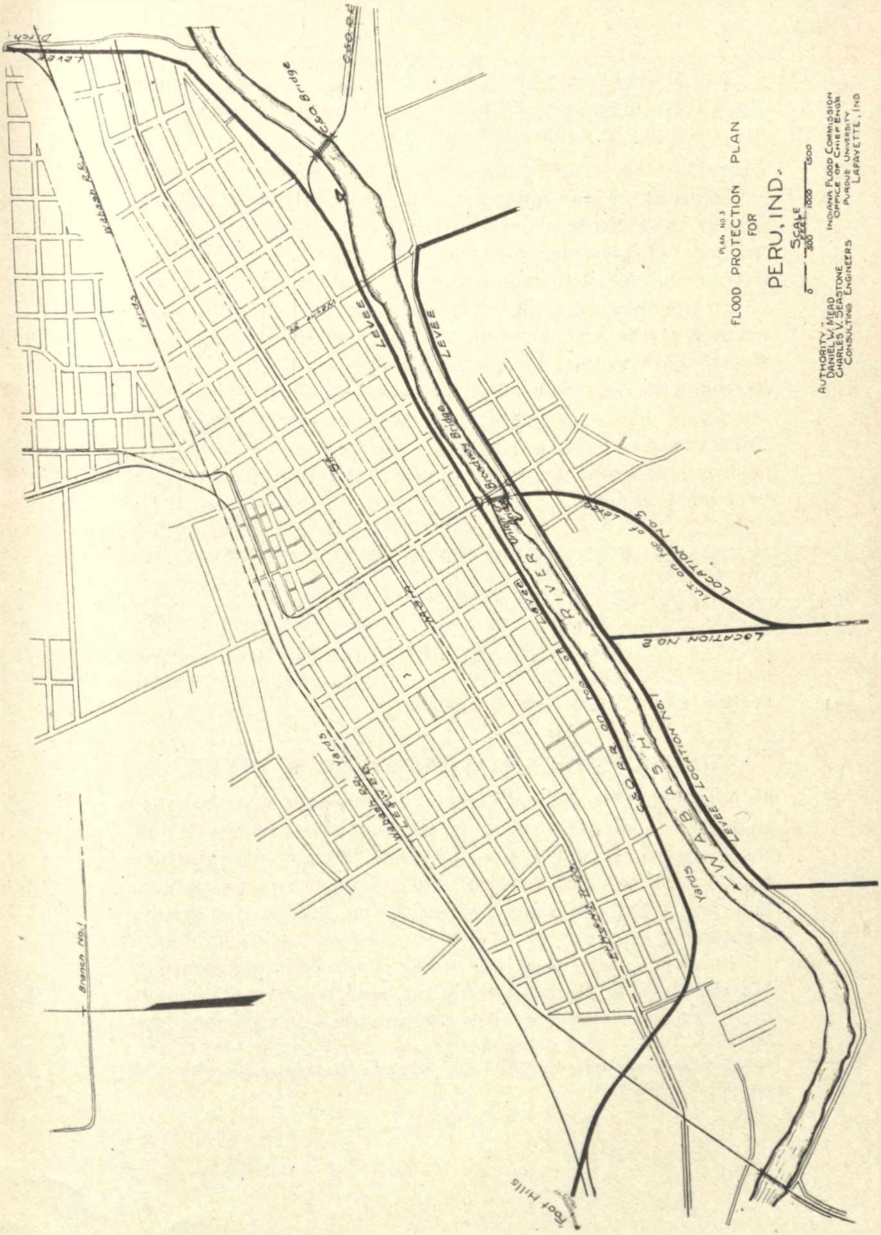
KOKOMO PLANS OF STREAM CHANGES.

PLAN No. 2.



FLOOD PROTECTION PLAN FOR FT. WAYNE, IND.
Authority: Report by A. W. Grosvenor.

PLAN No. 3.


PLAN NO 3
FLOOD PROTECTION PLAN
FOR
PERU, IND.
SCALE
FEET
0 500 1000 1500
AUTHORITY –
DANIEL W. MEAD
CHARLES V. SEASTONE
CONSULTING ENGINEERS
INDIANA FLOOD COMMISSION
OFFICE OF CHIEF ENGR
PURDUE UNIVERSITY
LAFAYETTE, IND
Ditch
LEVEE
Wabash R.R.
Yards
C&O Bridge
C&O R.R.
LEVEE
LEVEE
Broadway Bridge
Union St.
Main St.
WABASH RIVER
Levee
Levee on top of C&O R.R.
LOCATION No. 3
LOCATION No 2
LEVEE – LOCATION No. 1
Yards
Wabash R.R.
LEVEE
Yards
Foot Hills
Branch No. 1

At this point a remark must be made as to the depressing effects upon the character and industry of people who are continually liable to flood damage.

Other Methods of Mitigating Flood Damage.

Forestation may mitigate ordinary floods, but it does not appear that this is a practical solution in Indiana. Special methods of plowing, such as contour plowing, have been advocated. Mr. Freeman Thorpe of Hubert, Minnesota, advocates contour plowing. His idea is to so shape the upper surface of the ground, that it will be subdivided into relatively small units, entirely surrounded by ridges. In fact he would terrace, on a small scale, the side hill slopes. The elevations are so gradual that they do not interfere with the ordinary crop arrangement in handling. Practically each one of these terraced areas is a detaining reservoir of very small size.

FLOOD PROTECTION AND RIVER CONTROL.

As a matter of fact, flood protection is related to other problems. namely those of water supply, soil erosion, navigation, and water power. To diminish floods is to diminish soil erosion, which is one of the very serious problems affecting agriculture and navigation.

ANCIENT WORKS FOR CONTROL OF RIVERS.*

Water has been the element with which man has had to battle from earliest times. The problem of floods and flood control is not a new problem. From earliest times people have known the fearful consequences of water that has gotten beyond control, where from slave it has become master.

Those who witnessed the power of unrestrained water in March, 1913, know what it means, and has meant back to the dawn of civilization. Here is an element that when harnessed is gentle and gives friendly support, in so many ways, and when out of bounds becomes something terrible and sinister. Its destructive manifestation is not a quick flash of anger like that of a wind storm, but a slow gathering together, a remorseless and resistless rise of power.

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*Abstracted from paper by Sir William Willcocks, Engineering Record, Vol. 69, page 471, April 25, 1914.

The earliest records of civilization go back to the valleys of the Euphrates and the Nile and in both cases the ancient rulers of these regions counted it the very highest honor to have served the people by effectively controlling the floods and harnessing the waters to the use of the people.

In the valley of the Euphrates the success of agriculture depended then, as now, on the irrigation and the control of the river.

Our present methods of flood control were known to them. Indeed the more complete our knowledge of ancient people, the more our respect for them as engineers becomes. Ancient Babylonians controlled the Euphrates both by a system of levees along the banks to protect the agricultural lands in the low-lying districts, and they also drew off the flood waters from the upper reaches into escape basins which were depressions in the Arabian Desert, hundreds of square miles in area and twenty-five feet deep. The Tigris river was not controlled upstream and the dikes downstream frequently burst.

In Persia also, rivers discharging the volume of the Wabash at Lafayette were controlled by masonry dams.

Again the ancient rulers of Egypt built dikes along the Nile and drew off the flood waters into a wide and deep depression from which these waters were returned to the river after the flood for use in irrigation.

Indeed history abounds with a record of not only the use of flood protection works, but the cutting of them in times of warfare.

These ancient works were all thorough. They were effective and desirable, and presented an example of the benefits to be derived from associated action.

LOCAL VS. VALLEY INTERESTS.

A city may build improved channels and levees that sluice the water through the city and pile it up on communities down stream. Conversely, the county commissioners or railroad corporations may build a bridge that acts as a dam and backs the water up on persons up stream.

Again the levee system of a city, to be effective, must extend beyond the city, and will demand the widening of the railroad and county bridges.

As in the Miami Valley it might be found that the best interests of all parties will be served by the examination of the upper river for detaining reservoir sites.

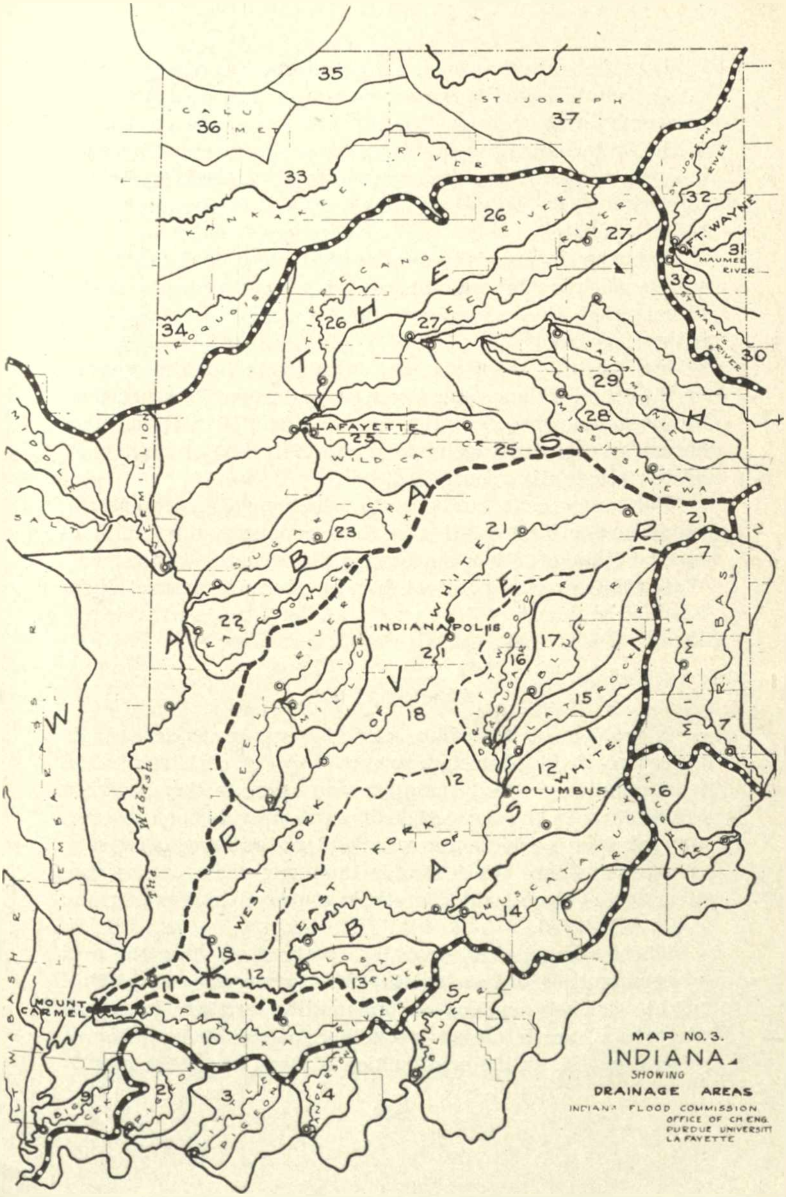
Indeed it is clear at the outset that flood protection problems must be viewed from a standpoint not of one locality, but of the entire watershed, both with respect to planning flood protection works, and providing for the cost of building them. The drainage areas of main streams of Indiana are shown in Map No. 3.

In Indiana the cities in the northern Wabash Valley have organized a Northern Wabash Valley Flood protective association, comprising the cities of Lafayette, Logansport, Peru, Wabash, Huntington and Fort Wayne. Fort Wayne has been included because its problems are of the same nature as those of the other cities. Indeed there is a physical possibility that Fort Wayne may protect itself by sending the waters of the St. Mary's River over a low divide into the Wabash River.

INTERESTS OF THE STATE IN FLOOD PROTECTION.

The entire facts presented thus far would naturally suggest to the reader that the state has a direct interest and can exercise a helpful co-ordination in flood protection problems of our people. It is the state that must study the problem from a wide point of view and on the underlying data such as rainfall and topography.

MAP No. 3.


MAP NO. 3.
INDIANA
SHOWING
DRAINAGE AREAS
INDIANA FLOOD COMMISSION
OFFICE OF CH ENG
PURDUE UNIVERSITY
LA FAYETTE
THE WABASH RIVER BASIN
CALUMET
ST JOSEPH
KANKAKEE RIVER
IROQUOIS
TIPPECANOE RIVER
EEL RIVER
ST JOSEPH RIVER
FT. WAYNE
MAUMEE RIVER
ST MARYS RIVER
SALAMONIE
MISSISSINEWA
LAFAYETTE
WILD CAT CR
VERMILLION
MIDDLE
SALT
SUGAR CR
RACCOON CR
EEL RIVER
MILL CR
WHITE
INDIANAPOLIS
WEST FORK OF WHITE
EAST FORK OF WHITE
DRIFTWOOD
SUGAR
BLUE R
FLATROCK R
COLUMBUS
MUSCATATUCK R
WHITEWATER
MIAMI
LOST RIVER
BLUE R
PATOKA RIVER
ANDERSON
LITTLE PIGEON
PIGEON
BIG CR
EMBARRAS
WABASH R
The Wabash
MOUNT CARMEL
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It is the state that must act as intermediary between the cities, counties, and corporations whose combined action is necessary in the construction of flood protection works. It is the state which must provide legislation arranging such co-operation and providing proper legal methods by which districts may be defined and money raised for building flood protection works.

It is the state which must see that these flood protection works, such as levees and reservoirs, are properly maintained, that they may be a real protection instead of a future menace.

Finally it is the state that is interested in the welfare of the whole people, and itself suffers when lives are lost, business and transportation are interrupted and sickness ensues, and entire communities are disturbed and set back by the constantly recurring floods.

Furthermore, it is the state which must represent the people in the final solution of these problems, through combined action of other states and the federal government. Watersheds are not political divisions, but are natural divisions and problems of flood protection have to do with watersheds.

LEGISLATION.

A problem of immediate great importance in Indiana is to secure flood protection works, that is, to finance the works and to properly maintain and regulate them. There are no laws in the State of Indiana to provide for construction of flood protection works, and no existing officers or commissions into whose hands the supervision of the construction of such works, or their approval and regulation, could be placed.

There is no control provided by the state over the acts of communities in constructing flood protection works that might seriously endanger communities further down the stream. There is no law providing for the co-operation of several parties to the construction of flood protection works, namely, the city, county, and suburban districts. Such a law is needed because a flood protection plan generally involves building levees along the banks of the river, the widening of county and railroad bridges, and extending the levees beyond the limits of the city.

For instance, the city of Peru was especially damaged by the flood of March, 1913. Seventeen lives were lost and the total damage was over $2,000,000. Immediately after the flood the citizens employed a competent engineer who planned flood protection works, consisting of a series of levees extending from the foothills above to those below town, along the river banks, and providing for the opening up of the county and railroad bridges.

The city of Peru can not now obtain the much needed protection unless legislation provides some means for the co-operative action, as between the city, county, railroad and outlying districts.

The state should also assume the supervision of our streams to prevent encroachments and channel obstructions that unreasonably obstruct the free flow of flood waters.

LEGISLATION IN OTHER STATES AND COUNTRIES.*

The French nation was eminent early in the history of water control and flood protection. A system of flood legislation originated in France, and upon it has been based the practice in other European countries. In France flood districts are established and administered by officers called prefects. They supervise the organization and administration of all water-control districts. The costs of the flood protection works in these districts are taxed on property in proportion to the benefits derived, largely through the establishment of zones of relative benefit.

Generally in Europe the construction and operation of flood protection works are administered by administrative officials, rather than through the courts.

In New York state, a Conservation Commission appointed by the Governor considers flood protection, and prepares, with the aid of a technical staff, flood protection plans. Before the works are constructed the final approval of the project rests with the legislature.

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*Prepared by E. W. Shirk, Chairman Indiana Flood Commission.

In Minnesota there is an ex-officio Commission consisting of the Governor and two other state officers, to which an engineering staff is attached.

The state of Ohio has made the greatest progress in flood legislation. After the flood of March, 1913, the legislature passed a Conservancy act under which petitioners in any locality may petition the courts of common pleas for the establishment of a conservancy district. The court determines the petition and may, after evidence, establish the limits of the district, appoint directors to build the works, and establish an assessment roll, assessing benefits and damages within this district.

These systems are described in greater detail below.

OHIO CONSERVANCY LAW.

Under petition filed in the office of the clerk of the court of common pleas and signed either by 500 or more freeholders or a majority of the free holders, or by the owners of more than half of the property in either acreage or value within the limits of the territory proposed to be organized into a conservancy district, the judge of this court, or if the conservancy district lies within more than one judicial district, the judges of such judicial districts sitting together set a date for the hearing of the petition, notice of which is published by the clerk of the court. If this hearing develops the necessity for the formation of a conservancy district, then the court decrees its incorporation and within thirty days appoints a board of directors of three resident freeholders within the district who shall administer the affairs of the district, employ agents and prepare a so-called official plan which is then given a hearing in the event of objections within thirty days of its filing. These directors upon final approval of the official plan have the right of eminent domain over all property in the Conservancy District, including public utilities, and may condemn for the use of the district according to the procedure provided by law. This board shall also have the right to establish and maintain, stream gauges, rain gauges, flood warning service, etc., and may co-operate with the United States government or other agencies or states to carry out the official plan. The court organizing the district appoints three appraisers, nominated by the board of directors, whose duty it is to appraise all benefits and damages accruing to all lands within that district. No appeal under the act is permitted to interrupt or delay the prosecution of any work under the act. The directors may issue bonds or borrow money or pay with warrants against the district, levy assessments and contract for all works provided under the official plan. Their acts are limited by the official plan and they are under no supervision. The difficulty which has so far developed in Ohio, with this conservancy act has been in securing the agreement of the various judges sitting together, whose approval has been necessary for the establishment of conservancy districts.

NEW YORK CONSERVATION LAW.

The New York law establishing a Conservation commission is almost the opposite of the Ohio law, the sole object of which is to provide for protection against floods. The New York Conservation commission has authority over hydraulic development, river improvements, drainage, water supply, forests, public parks, etc.; this very wide field of activity involves in addition to the three commissioners, the employment of three deputy commissioners and a variety of secretaries, engineers, etc. So far as flood prevention goes, it may proceed with the establishment of a district on petition of a public corporation, a private individual or on its own motion after an examination into the necessity for the proposed improvement, and after holding an advertised public hearing in regard to it. But the letting of contracts under any plan of improvement and the authorizing of bonds, which are issued and signed by the Commission, must await the approval of the plan by the legislature of the state. The Commission is given the right to condemn property where necessary for the execution of the plan. The Commisson determines the necessity for it, and upon receiving the legislature's approval, finances and erects all works.

FRENCH WATER CONTROL LAWS.

In France protection against floods is affected either by:

(1) Voluntary associations under the law of June 21, 1865.

(2) Compulsory syndicates organized by the administration of the district or the government, by authority of the law of September 16, 1807.

(3) Or by the government itself, under the law of May 28, 1858. When the works are especially for the protection of cities, projects are worked out, in the case of voluntary associations, by the engineers of a commission appointed by such association and must be approved by the prefect, and shall also be submitted for the approval of the minister of public works. Voluntary associations cannot enforce membership or condemn, and are in fact restricted to minor works where the members are few and their interests are altogether in common.

When the project is carried out under the law of 1807, by a compulsory syndicate, the taxes are apportioned on the basis of the following:

(1) The fixation of the boundaries of protection.

(2) Classification of the properties included within these boundaries into different zones, called "zones of danger" according as they are more or less exposed to overflow.

(3) Establishment of these same boundaries.

This system, combined with the classification into zones gives the measure of the benefit received from the works by each proprietor. Plans showing the proposed boundaries must be attached to the decree ordering the execution of the work which is ordinarily made by the prefect. All such projects are of course subject to legal review. Bonds may be issued, authorized by the prefect, by the syndicate to carry out the works of a compulsory association.

In the event the government undertakes flood control works there is no public participation in the determination of the scope of or the management of such works.

GERMAN WATER CONTROL ASSOCIATIONS.

German water laws have been very largely adapted from the French. The larger German basins, however, have been covered by specific water control statutes. The German associations for water control may be either "free" or "public." Both kinds have by law the rights of legal persons. Free associations have merely the rights of a private citizen. Public associations are bodies with public rights. Both can acquire rights to contract obligations under their names as well as acquire property, take legal proceedings before a court, etc. Their usual court of proceedings is that of the district in which they are located. The associations must have a board of directors which represents it in all matters. Free associations are voluntary; hence without a compulsory combination of the dissenting minority and must only register with the local court in order to establish themselves. No government approval is necessary. They are not adapted to large undertakings and have small importance compared with the "public associations."

The founding of a "public association" requires, in consideration of the rights and duties thereof, as well as on account of the co-operation of the government authorities in construction and supervision, proof that it has for its purpose a public or common use. It is not only a legal person in relation to private rights, but it also has the character of a public corporation and therefore falls under government supervision and control. Entrance is free and only in the cases of especially important associations can a resident proprietor be compelled to join, and then only upon the showing that the works of the association require it. The consent of the majority of the lands involved is necessary for the formation of a public association and in this vote only the proprietors of lands included in the undertaking can participate, the vote being taken on the basis of assessed values with the scale so arranged that each member has at least one vote. Motions for the formation of "public associations" are received either from property owners, or, in the public interest, from the president of the administrative district, or, in the case of cities, from the city council. The formation of an "association" depends upon the vote of its prospective members. After an affirmative vote is secured, a minister (usually the minister of agriculture) approves it. All the preliminary steps in the formation of the "association" are presided over by a temporary commission usually appointed by the president of the administrative district.

IN GENERAL.

There are several fundamental differences between the foreign water control laws and our American drainage and water control statutes. Abroad the district is formed by Administrative instead of Judicial authority. The members vote. All details of operation are contained in the statute or by-laws instead of in the law itself.

The Indiana Flood Commission is at present examining the merits of the various methods of providing for flood protection by legislative act, and determining which of these best fits our state conditions.

TABLE No. 3.

A COMPARISON OF DRAINAGE AREAS.

STREAM.	Area.			Total.	Per Cent. of State.	Percentage Taken Separately.			Total Length of River.	Mean Slope of Drainage Area.	Rainfall, 23-27, Mch. 1913.
	Illinois	Indiana	Ohio						Miles.	Ft. to Mile.	Inches
WABASH SYSTEM	9,028	23,829	358	33,215	66.1	100.0					6.8
White River*		11,281		11,281	31.2	47.3	100.0				7.8
West Fork		5,371			14.8		47.6	100.0		2.22	7.5
Eel River		925			2.5			17.2	91	5.47	6.4
Mill Creek		285			0.8			5.3	51	5.01	5.25
Other Streams		4,161			11.5			77.5			
East Fork†		5,910			16.4		52.4	100.0		4.22	8.1
Lost River		348			1.0			5.9	70	11.71	7.8
Muscatatuck River		1,108			3.1			18.7	52	6.0	8.4
Flat Rock River		516			1.4			8.7	88	5.7	9.7
Driftwood River‡		549			1.5			9.3	72	5.8	7.5
Blue River		644			1.8			10.9	74	5.7	8.00
Other Streams		2,745			7.6			46.5			
Wabash River	9,028	12.548	358	21,934	34.9	52.7	100.0		482	1.39	6.2
Big Creek		198			0.5		1.6		40	3.95	6.0
Patoka River		895			2.6		7.2		148	2.26	7.5
Raccoon Creek		519			1.4		4.1		65	12.00	8.4
Sugar Creek		875			2.3		7.0		80	6.56	5.64
Wild Cat Creek		769			2.1		6.1		64	5.92	6.5
Tippecanoe River		1,889			5.2		15.0		133	3.22	4.96
Eel Eiver		864			2.4		6.9		79	3.23	5.5
Mississinewa River		855			2.4		6.8		124	3.1	8.08
Salamonie River		528			1.5		4.2		85	6.7	7.0
Other Streams		5,086			14.1		40.5				
Little Wabash River	3,517										
Embarras River	2,367										
Vermilion River§	1,538	70		1,608	0.2		0.6				5.5
Other Streams	1,606										
MAUMEE SYSTEM		1.186			3.3	100.0					
Maumee River		266			0.7	22.4			25		5.36
St. Joseph River		581			1.6	49.0			31		5.39
St. Mary's River		339			1.0	28.6			39	2.8	7.31
OHIO SYSTEM		5,733			15.9	100.0			351	0.3	7.0
Miami River		97			0.3	1.7					10.17
Whitewater River		1,318	21	1,339	3.7	23.0			‖ 17	¶	9.3
Pigeon Creek		324			0.9	5.6			36	7.7	5.52
Little Pigeon Creek		369			1.0	6.4			41	5.3	5.60
Anderson River		273			0.8	4.8			41	13.4	5.78
Blue River		452			1.2	7.9			65	6.6	6.14
Laughery Creek		354			1.0	6.2			57	14.3	7.17
Other Streams		2,546			7.0	44.4					
Other Streams		5,297			14.7						
Total Area of State	9.028	36.045			100.0						
Percentage of Wabash System	27.2	71.0	1.8	100.0							

* Length, 50 miles; area, 176 square miles. † Including White. ‡ Including Sugar Creek.
§ Including Lt. Vermillion. ‖ East Fork, 52; West Fork, 67. ¶ E. Fork, 8.9; W. Fork, 4.5.

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Ind-Conservation of resources

The Why and Wherefore of Conservation in Indiana

The Department of Conservation
State of Indiana

DIVISIONS OF
Geology
Entomology
Forestry
Lands and Waters
Fish and Game

REFERENCE
DO NOT CIRCULATE

CONSERVATION COMMISSION
W. A. GUTHRIE, Chairman, Dupont
JOHN W. HOLTZMAN, Indianapolis
STANLEY COULTER, Lafayette
RICHARD M. HOLMAN, Crawfordsville

RICHARD LIEBER, Director
THE DEPARTMENT OF CONSERVATION

1919

EMELINE FAIRBANKS MEM. LIBRARY

ARE YOU ONE OF THESE?

Do you fish and hunt? Are you a farmer and do you have trouble with insects or diseases on your crops? Are you contemplating planting forest trees, cutting out some of the timber you have, growing fence posts, planting street trees? Do you need information on any Indiana soils, or do you want to know the composition of a certain limestone, or do you want any information on the mineral deposits of Indiana? Are you interested in visiting state parks for a day or to spend your vacation? Or do you want to start a campaign to preserve some primitive tract, historical landmark, or any spot of educational value?

If you are interested in any of the above items or questions of a like nature, write, phone, telegraph or visit **the Department of Conservation** of the State of Indiana in the State House in Indianapolis.

The department consists of a force of scientists and experts, whose business it is to bend every effort and to bring every possible aid to bear upon the conservation of Indiana's natural resources. The force is at the service of the public. It is absolutely nonpolitical in organization. Conservation is an immediate and urgent question. The Department of Conservation needs you and you need it. You are urged to make use of its service.

OUR AIM

> TO MAKE EVERY HOOSIER A CONSERVATIONIST, WHO BELIEVES IN THE STATE AND THE LAWS WHICH ARE IN FORCE TO CONSERVE ITS NATURAL RESOURCES FOR THE BENEFIT, EDUCATION AND RECREATION OF ALL HOOSIERS NOW AND TO COME.

CONSERVATION IN INDIANA

For at least ten years you have heard and read about conservation. You knew it had something to do with natural resources, timber, coal, streams and the like but too often judged it to be the plaything of high officials and theme for oratorical display. If you haven't now you should have come to realize that conservation is of immediate need to you and me, our neighbors, our children, our children's children and all who are to come after us.

Conservation of natural resources—what does it signify? Whom does it concern? It concerns the nation—the state—the individual. The Indiana situation is this—Nature gave to Indiana a magnificent heritage of timber, coal, gas, oil, limestone, prairies, streams alive with fish, woods abounding with game, and magnificent beauty in deep woods, great canyons, quiet streams, and delightful lakes. We and our forefathers have taken these gifts and used them lavishly, with but little thought of the future. We are brought to a sudden stop when we find that our supposedly endless wealth is really and very rapidly reaching an end. The demand for timber increases, the supply is limited—the prices are extremely high—gas and oil are going—fish and game are hard to catch and find because there is so little—lakes are being ruthlessly drained—the great demand is fast removing the limestone deposits —natural primitive scenery is very rare—maintenance of our soil fertility is a problem of supreme importance—insects and diseases cut down our crops.

Indiana is meeting the question. The legislature passed a law creating the Department of Conservation on April 1, 1919. Heretofore there had been the departments of geology, entomology, fish and game, and forestry each working separately but all interested in conservation. The Department of Conservation gathers all these under one head and adds the division of Lands and Waters. The result is well directed effort with no duplication and the whole an efficient organization.

THE DIVISION OF GEOLOGY

Indiana has had a State Geologist since 1869. A great amount of valuable work in scientific investigation has been accomplished with special attention to the discovery of minerals, and all raw material which the earth affords for use in agriculture, road making, manufacturing and building. Coal, oil and gas were discovered in abundance over the State which caused the great industrial development which Indiana has seen in the last fifty years.

Attention is called to the importance of the development of the natural resources to the farmer. Limestone has become one of the principal crop agents and thousands of tons are applied yearly to the Hoosier fields. The Division of Geology has determined the extent of the limestone and marl beds of the State as well as their availability and chemical analyses. Limestones vary greatly in their efficiency in neutralizing acidity and their analysis determines which are most desirable.

Soil is Indiana's greatest natural resource. Soil surveys have been completed in 84 counties in the State by the Division of Geology in conjunction with the U. S. Geological Survey. This work is of daily use and of inestimable worth to the farming industry.

The building limestone industry which stretches along the Monon from Greencastle south, furnishes material for buildings throughout the United States and much is used in foreign countries. This industry brings approximately $5,000,000 into Indiana each year. In the same region the cement industry flourishes with its huge mills in almost every town.

The northeastern gas and oil fields have passed their zenith and are now surpassed by the southwestern fields. Indiana coal fields support an enormous mining industry. In 1918 there were mined 27,000,000 tons and the output increases yearly.

The division has available information on coal, soil, gas, oil, limestone, clays, shales, sandstones, sand, gravel and all mineral deposits of the State. REQUESTS FOR INFORMATION ARE WELCOMED.

EMELINE FAIRBANKS MEM. LIBRARY

DIVISION OF ENTOMOLOGY

The Division of Entomology inspects all nurseries in the State and issues certificates of inspection to those whose nurseries are found satisfactory.

Nursery agents are licensed and we are trying to drive the crooked nursery agent out of the State. You can help us do this by asking to see the license of any one selling nursery stock, and if they do not have a license report to this office, giving their name and address, and also report him to the prosecutor of your county.

The apiary inspection is all carried on by this department. This year by August first we had inspected 15,212 colonies in 1,292 different apiaries and held 126 demonstration meetings. At these demonstration meetings the beekeepers were shown all the symptoms of Foul Brood and the work of transferring was actually done so there would be no doubt as to their misunderstanding the methods of treatment. Then the beekeepers could ask for instructions along any lines of beekeeping and the actual work would be done in their presence. If none of these meetings have been held in your neighborhood you should arrange to have one next season. It is now unlawful to keep bees in box hives or old gums and if you have any in such shape arrange to transfer them to movable frame hives.

The department identifies insects and plant diseases and makes recommendations for the control of pests and diseases. If you are in doubt as to the cause of your plants dying or the name and methods of control of insects causing damage to your crops or household, send specimens to the Department of Entomology and we will assist you. Do not hesitate to use this office, the work of the department becomes more valuable to the State when more records of insect or plant disease damage is reported to us. When you send in specimens of your troubles you are assisting us in our work as it helps us make more complete records of insect pests and we can often check a serious outbreak if we are notified in time.

The work of the department this year in the prevention of a statewide quarantine on small grains by the Federal Horticultural Board on account of the "Take All" disease of wheat is an example of the value of this department to the State of Indiana.

MAY WE HAVE YOUR CO-OPERATION AND ASSISTANCE?

DIVISION OF FORESTRY

The present price of lumber emphatically calls attention to our future supply of timber. Owners of forest lands should adopt a policy of conservation and a wise management of the remnant of our forests.

The Division of Forestry will give you free advice on the management of your forest lands, will tell you what trees to cut and what trees to leave to make your forest most profitable. If you wish to plant forest trees we can give you a list of nurserymen who sell forest tree seed and seedlings. If you wish to plant forest trees in your woods, along the roadside, about schoolhouses, churches, or about your house, we will make suggestions as to the most desirable trees to plant, the best size of trees to use and the spacing the trees should have.

If you wish an object lesson on the management of forest lands, and have to start a forest by planting trees, we invite you to visit the State Forest in Clark County, one mile north of Henryville, where you can see all the most desirable trees planted in pure and mixed stands and given several widths of spacing.

If you have timber to sell we can send you a list of the buyers in the State, or those in your immediate vicinity.

OUR PUBLICATIONS ARE FREE FOR THE ASKING

We can supply you with a folder on the Planting and Care of Shade Trees, The Care of the Farm Woodlot, Fire and Forestry Laws of the State; several of our annual reports which contain a wealth of information on the subject of forestry; suggestions for the teaching for forestry in the public schools, which are supplied to teachers.

REMEMBER THE FORESTRY DEPARTMENT IS ANXIOUS TO HELP YOU.

DIVISION OF LANDS AND WATERS

The division of Lands and Waters was created under the conservation act in April, 1919. The most important work is the creation and maintenance of state parks. Turkey Run in Parke County and McCormick's Creek Canyon in Owen County are the two parks now owned by the State. Turkey Run is a large tract of virgin wilderness lying along the banks of Sugar Creek and Turkey Run. It is noted for its great trees, magnificent limestone canyons and scenic beauty. This park is used by more than 50,000 people annually for outings and vacations. It is one of the very few tracts of virgin timber left in the State and constitutes a splendid memorial to our pioneer forefathers and at the same time is of great recreational and educational value.

McCormick Canyon is a tract of splendid second growth along the banks of McCormick's Creek, which has cut a very beautiful canyon through the park. It is capable of development into a beautiful tract and will soon rival Turkey Run in popularity.

The division has jurisdiction over the beds of navigable streams and inland lakes. Sand, gravel and coal only to be taken from these waters with permission of the Department of Conservation. This goes far in preventing a wholesale destruction of Indiana's heritage in beautiful streams and lakes. Also investigation is being carried forward to ascertain the amount of pollution in streams by sewage and factory wastes. This has ruined the beauty of many streams and killed the fish. This matter will be dealt with as soon as the necessary facts are established. We may soon expect to have back our fishing waters, swimming holes and boating waters which have been usurped by emptying of waste into streams.

The Lands and Waters division has for its future work the establishment of a great system of state parks for the recreation of Hoosiers, the cleaning up of Indiana's streams through protection against pollution, and revival of fish life, and conservation of our lakes and streams from destructive hands. Recreation, annually, becomes of greater importance and our beauty spots must be reserved for this purpose.

THE DIVISION OF FISH AND GAME

The maintenance and protection of Indiana fish and game supply is of supreme interest to every Hoosier. The work is carried on by the division of fish and game through an efficient corps of game wardens and the propagation and distribution of fish from state hatcheries.

With the organization of the Department of Conservation, the game warden service has undergone a severe reorganization with a greatly increased efficiency as a result. The fish and game laws are being strictly enforced. Violators of the law are quickly brought to trial and punished. Hoosier citizens are coming to realize that the game warden is one of their best friends, that he is the policeman of conservation, and that his work is for the good of the public.

The state fish hatcheries propagate thousands of fish each year. These are used to stock Indiana's streams and lakes. Were it not for this work many Hoosier waters would now be totally depleted of fish. Fish for your local waters may be had on application. Farmers will be interested in the work of the hatcheries in stocking private ponds. They are urged to provide or build private fish ponds, and the State will furnish bass for them on application. Few realize the productiveness capable from an acre fish pond. It means ample fish to keep the farmer's table supplied and many pounds to sell. A letter to the Department of Conservation will bring directions for making a fish pond.

The division of Fish and Game needs co-operation of all citizens in prosecuting the dynamiters, the seiners, gig-users and hunting out of season. The laws are solely for the necessary protection of wild life. If we are to continue to enjoy it, the laws must be enforced. Every citizen must be ready to aid in findings of violators, giving necessary information and affording the game warden every opportunity to carry on his work.

The hunting and fishing license is your card which qualifies you as a conservationist. The money you pay for it is used to prosecute the fish and game hog, the dynamiter, the seine user and the chap who hunts out of season, and the propagation of fish to restock Indiana streams and lakes.

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Assessment of Forest Land

Reprint of an act to classify and assess certain lands as forest land, which was passed by the Indiana Legislature in 1921. A few explanatory notes have been added by Chas C. Deam, State Forester.

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CONSERVATION COMMISSION

W. A. GUTHRIE, Chairman
STANLEY COULTER
JOHN W. HOLTZMAN
E. M. WILSON, *Secretary*

REFERENCE
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PUBLICATION 19

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THE DEPARTMENT OF CONSERVATION
STATE OF INDIANA
RICHARD LIEBER, DIRECTOR
1921

*AN ACT TO ENCOURAGE TIMBER PRODUCTION AND TO PROTECT WATER SHEDS BY CLASSIFYING CERTAIN LANDS AS FOREST LANDS; AND PRESCRIBING A METHOD OF ASSESSING [APPRAISING] LANDS THUS CLASSIFIED FOR PURPOSES OF TAXATION

Section 1. Be it enacted by the General Assembly of the State of Indiana, That: Classification of Lands. For the purpose of taxation, certain forest lands, hereinafter defined as "forest plantations" and "native forest lands" shall be classified and assessed as provided in this act. The term "forest plantation" as used in this act shall be construed to mean any piece of cleared land which has been regularly planted with and has growing thereon timber producing trees to the number per acre as hereinafter provided. The term "native forest land" as used in this act shall be construed to mean any piece of land which has never been plowed or cultivated and which contains native timber producing trees, of varying ages, to the number per acre as hereinafter prescribed: Provided, That pomaceous trees shall not be counted as timber producing.

Sec. 2. Forest Plantations and Native Forests Defined. Any piece or parcel of land to be classified as forest plantation shall have growing thereon the following number of healthy, living timber trees per acre; if the trees are one year old, there shall be at least 600 trees per acre; if the trees are two years old, there shall be at least 500 trees per acre; if the trees are not less than three nor more than five years old, there shall be at least 400 trees per acre; if the trees are not less than six nor more than ten years old there shall be at least 300 trees per acre; if the trees are not less than eleven nor more than fifteen years old, there shall be at least 200 trees per acre; if the trees are not less than sixteen nor more than twenty years old, there shall be at least 175 trees per acre; if the trees are not less than twenty-one nor more than thirty-five years old there shall be at least 150 trees per acre; if the trees are not less than thirty-six nor more than fifty years old, there shall be at least 125 trees per acre; if the trees are not less than fifty-one nor more than seventy-five years old, there shall be at least 100 per acre; and trees older than seventy-five shall be credited with occupying 900 square feet of space. In the event that it is impossible for the owner of any plantation too [to] have the prescribed number of even age trees growing thereon, on account of death or maturing of some, then smaller trees shall be planted among the larger trees so that all of the available tree growing space shall be occupied. Trees less than one inch in diameter at a height of four feet above the ground shall be credited with occupying 65 square feet of space; trees not less than one and more [less] than two inches in diameter at a height of four feet above the ground shall be credited with occupying 85 square feet of space; trees not less than two and less than four inches in diameter at a height of four feet above the ground shall be credited with occupying 110 square feet of space. Trees not less than four and less than six inches in diameter at a height of four

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*NOTE: Unfortunately a few manuscript and typographical errors appear in the law. The corrections are made in brackets.

feet above the ground, shall be credited with occupying 150 square feet of space; trees not less than six and less than eight inches in diameter at a distance of four feet above the ground shall be credited with occupying 200 square feet of space; trees not less than eight and less than ten inches in diameter at a distance of four feet above the ground shall be credited with occupying 300 square feet of space; trees not less than ten and less than fifteen inches in diameter at a height of four feet above the ground shall be credited with occupying 450 square feet of space; trees not less than fifteen and less [than] twenty inches in diameter at a height of four feet above the ground shall be credited with occupying 600 square feet of space and trees twenty inches in diameter or larger at four feet above the ground shall be credited with occupying at least 650 square feet of space. The stand of trees on any such forest plantation shall be a good stand as that term is understood by competent foresters and as shall be determined by the state forester and no open areas shall be permitted. If a tree dies or is removed the vacancy shall be filled by planting seed or seedlings therein. The number of seeds of [or] seedlings planted shall be sufficient to fully stock the open space. When open spaces are first replanted, the trees planted therein shall be spaced not more than eight feet apart and each tree planted shall be allowed a space of 64 square feet. When the owner of a plantation wishes arable land and wishes a wide spacing, he shall be permitted to use a spacing as wide as 8x8 feet and be permitted to grow a nurse crop between the rows for a period of two years. The state forester may authorize the planting of additional trees within any such space and shall indicate how and where they shall be placed. The owner of any parcel of land classified as native forest land shall have three years from date on which such land is entered for taxation as native forest land by the county auditor, as hereinafter provided to seed or plant such land, and if at the end of such time such land shall not be fully stocked, such owner shall furnish satisfactory reasons to the state forester for failing so to do. A native forest land shall be deemed to be fully stocked when it shall contain at least 1,000 timber trees of any size per acre, exclusive of pomaceous trees. If coppice shoots are counted as trees, only one from each stump shall be counted. The following trees shall not be deemed timber trees within the meaning of this act: Dogwoods (Cornus); Water-beech (Carpinus); ironwood (Ostrya); red bud (Cercis); sassafras; persimmon; pawpaw; black haw; and willows (Salix). No areas within any such native forest shall be free of trees. Every open space shall be growing trees of same [some] age. The minimum stand of trees shall be regulated by the state forester and his instructions and decisions in regard to what constitutes a stand of trees within the meaning of this act shall be final.

Sec. 3. Amount Assessed. All forest plantations and native forest lands shall be assessed at the rate of one dollar per acre.

Sec. 4. Application for Classification. Any person or firm or corporation, wishing to have any land classified according to the provisions of this act shall obtain application blanks from the state forester for that purpose. The state forester shall send the applicant two blanks which shall be filled out and filed as hereinafter provided before the land shall be deemed to be classified within the meaning of this act. After receiving the application blanks the applicant shall have the parcel of land proposed for classification surveyed by metes and bounds and located with reference to some established corner. In addition, the parcel of land shall be located as to section, township, range and county; two plots of the survey shall be made in ink, and on a scale of 100 feet to the inch, such plot shall show true north, the length of each side of such parcel of land in feet and inches, the size of all enclosed angles, the magnetic bearing, and the angle of the line connecting the plot with an established corner. Each plot shall be made a part of the application; one copy of the plot shall be sent to the state forester and the other shall be filed and recorded in the office of the recorder [filed in the office of the auditor], of the county in which such parcel of land is situated. The person making the survey of the tract shall fill in the necessary and appropriate part of the application and sign the same as hereinafter prescribed. The applicant shall then have the land appraised by the township assessor of the township in which such parcel of land is situated and said appraisement shall become a part of the application and the township assessor shall sign the appraisement as hereinafter prescribed. Each application shall be signed by the owner or owners, surveyor, and the township assessor making the appraisement. The signatures of each shall be witnessed by two legal voters of the county in which such parcel of land is situated. One application shall be filed and be made of record in the office of the recorder of the county in which such parcel of land is located, and the second application shall be sent to the state forester. If, in the judgment of the state forester the application and the land to be classified complies with the provisions and intent of this act, he shall at once notify the county auditor of the county in which the land is located that the land described in the application has been duly classified as a forest plantation or native forest land as the case may be, and thereupon, the auditor shall enter the same for taxation as provided for in this act.

Sec. 5. Surveyor's Charge. The county surveyor in making such surveys shall not charge more than the legal rate for land surveys of a similar character.

Sec. 6. How Assessment [Assessed]. Any parcel of land designed for classification shall be assessed [appraised] at the true cash value, which shall include any mineral, stone, oil or gas value it may have. The standing timber on such land shall not be considered in making the assessment [appraisement]. In addition to assessing [appraising] the parcel of land in question, all of the remaining land in the section in which the parcel lies, outside of cities and towns shall also be assessed [appraised] at the true cash value, exclusive of buildings and other improvements. In making such assessments [appraisements] each quarter section shall be valued separately and so designated. All assessments [appraisements] shall be entered in ink on the application blank. If the assessment [appraisement] as made by the township assessor is not satisfactory to the owner, he may appeal to a board consisting of the assessor, auditor and treasurer of the county in which such parcel of land is situated and the decision of such board shall be final.

Sec. 7. Expense of Survey and Assessment. The expense of the survey of the tract shall be borne by the applicant. The expense of the initial and withdrawal appraisement shall be borne by the county in which such tract is situated and shall be paid out of the general fund. For their services in assessing and appraising forest lands, as provided for in this act, the township assessor, county assessor, county auditor and county treasurer, or any of them shall receive their necessary expenses in doing such work.

Sec. 8. Area. No parcel of land shall be received for classification unless it contains at least three acres, and such tract may be of any shape whatsoever.

Sec. 9. Dwellings. No land shall be classified under this act which has situated thereon any dwellings or other buildings. Nothing [contained] in this act contained shall prevent the owner thereof from maintaining a sugar camp thereon and utilizing the trees for that purpose, or from operating a saw mill therein, to utilize the timber grown on the land so classified.

Sec. 10. Grazing, Etc. No land classified under this act shall be grazed by any domestic animal, nor shall any domestic animal be permitted to roam over such land. The provisions of this section shall not apply to domestic fowls.

Sec. 11. Sale of Land. No sale or other conveyance of classified land shall release the purchaser thereof, or any other person acquiring an interest therein, from any obligation or liability imposed by this act.

Sec. 12. Signs. All parcels of land classified under this act shall be marked by four signs placed on the boundary thereon and so arranged on different sides of the tract as to be the most conspicuous to the public. Such signs shall be furnished by the department of conservation, and shall be such size and have such wording as the department of conservation may designate.

Sec. 13. Assessment of Wealth other Than Forest. In the event that any oil, gas, stone, coal or other mineral is obtained from any such land as classified, the tract may be at once assessed for said oil, gas, stone, coal or other mineral wealth and placed on the tax duplicate.

Sec. 14. Special Permits. If occasion should arise where the owner of any classified land should desire a special permit in the management of classified land for any purpose deemed advisable by the state forester, and not inconsistent with any of the provisions of this act [;] the state forester is hereby empowered to issue such a permit which shall be in writing and shall be approved by the proper township trustees [trustee,] county assessor and county auditor and shall be filed and recorded in the office of the county reocrder.

Sec. 15. Inspections. It shall be the duty of the state forester to duly inspect each parcel of land so classified at any time. On such inspection trip he shall, if possible, have the owner go over the tract with him and point out to the owner any needed improvements and shall submit to the owner in writing a report of the inspection with recommendations. A permanent record shall be made of each inspection in the office of the state forester.

Sec. 16. Withdrawal. Land classified under this act may be withdrawn from classification by the owner at any time. The owner may signify his intention of withdrawing his land from classification by writing to the state forester for two withdrawal blanks, which shall be duly sent, and shall be properly filled out by the owner. Upon receipt of the blanks the owner shall have the property appraised in the same manner in which it was appraised when it was classified. The standing timber at this time shall not be considered in the assessment [appraisement]. If the appraisement as made by the township assessor is not satisfactory to the owner, he may appeal to a board of [,] consisting of the assessor, county auditor and treasurer of the county in which such parcel of land is situated and the decision of such board shall be final.

Sec. 17. Tax. Upon the withdrawal of land from classification, the owner of such land shall pay thereon as hereinafter provided, an unearned increment tax. The sum of the increment tax shall be the sum of the last appraisement less the sum of the first appraisement. Twenty-five per cent of the increment tax shall be paid unto [into] the state treasury; 50 per cent into the county treasury and 25 per cent into the township treasury.

Sec. 18. Cancellation. If the state forester finds that the provisions of this act are not being carried out, and the owner refuses to do so, he shall at once file a withdrawal notice with the county auditor, and the owner, and proceed to have the land withdrawn from classification, following the procedure as prescribed in section 16.

The increment tax shall be a lien upon the land classification [classified] and the failure to pay such tax shall take the same course as delinquent taxes.

Sec. 19. The owner of any tract of land classified under the provisions of this act shall report once each year to the state forester on blanks to be furnished by the state forester. Any person who shall make any false statement relative to any land classified under the provisions of this act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not to exceed $250, to which may be added imprisonment in the county jail or the state farm for a period of not more than six months.

NOTES ON THE PRECEDING LAW.

BY

CHAS. C. DEAM, State Forester.

NOTE: These notes are simply explanations and are not to be construed as legal interpretations.

Section 1. A study of the rate growth of Indiana trees shows that ordinarily it takes from 50 to 100 years for the fastest growing trees to reach a diameter of one foot; and 100 to 200 years for the slower growing trees. The average for all species would be about 100 years. It is well known that a forest investment extends over a long period of time with a profit so small that forest land can not afford to pay the present rate of taxes.

Sec. 2. Ordinarily the farmer's woodlot is on the rear of the farm. In this position the only profit it yields is the timber produced, assuming that no well managed woodlot is grazed. A better location for a woodlot would be to surround the buildings, orchard, and garden of the farm. If so located the owner would receive as benefits in addition to the timber produced a protective value to his buildings, stock and orchard that would exceed the value of the timber produced.

If a landowner has no woodlot, or a decrepit one he is advised to plant five to eight per cent of his farm to forest trees. To comply with the provisions of this law the trees should not be planted farther than 8x8 feet apart. When so planted a crop, corn preferred, could be grown between the trees for two years. When trees are planted 8x8 feet apart, an acre would contain 600 trees, which allows for 80 failures the first year. It is the best management to replant the failures the following year so as to secure even natural pruning.

A native forest would be considered well stocked if the crowns (tops) of the trees form a complete canopy. Open spaces in a woods must be planted with seed or seedlings, and it is best to plant such seed or seedlings 5x5 feet apart, or 6x6 feet apart in order to get a complete stand as quickly as possible.

Sec. 4. One side of the application blanks will be ruled in cross-sections to a tenth of an inch. On this side of the blank the surveyor shall plot the area surveyed to a scale of 100 feet to the inch and shall indicate the length of each side in feet and inches and the width of all enclosed angles. In addition if there is no established corner on the margin of the tract, he shall give the length of a straight line and enclosed angle which connects the tract with some established corner. In the event the area is too large to be plotted to a scale of 100 feet to the inch reduce the scale to 150 or 200 feet.

Sec. 6. The object in assessing all the land in the section is to serve as a check in obtaining the true valuation of the land classified.

Sec. 9. The reason no buildings are permitted to be on classified land is to prevent owners of cottages in woodlands about lakes and owners of expensive suburban homes from classifying their buildings under this law.

Sec. 10. The reason no grazing is permitted is because it is not consistent with the best forest management. A well managed forest should have a good stand of small trees growing to take the place of older ones when they are cut. Grazing prevents this. If the annual rings of growth of a stump are counted, it will be found that they are not uniform and often are quite variable. The variations are most often due to favorable growing seasons. Moisture is favorable to rapid growth. Grazing favors a loss of moisture by trampling and by cutting up and disturbing the leaves that help to conserve the moisture.

Sec. 12. The object of signs is to call the attention of the public to the proper management of a forest. Also, in the event the owner is violating any provisions of this act, it is hoped that some one interested in law enforcement will notify the Department of Conservation.

Sec. 17. Since land classified as forest land is practically exempt from the burden of public improvements such as roads, bridges, school buildings, etc., which increase the value of land; and to prevent the owners of land near cities from classifying land for speculative purposes, it is necessary and just that any increase in the value of land classified should be paid to the commonwealth which made the land more valuable.

Sec. 19. The annual report is to be a heart to heart talk of the State Forester with the owner. It is the duty and desire of the State Forester to co-operate with the owner so that the owner can manage the forest as economically as possible and see that the owner manages to get the greatest returns from it. The State Forester will inspect the forest from time to time and from the annual reports he will ascertain if his recommendations are being carried out and learn from the owner how the forest is progressing. Questions will be asked such as: Has any part of the forest been burned over? How much? Estimate the damage caused by fire, etc.? Was there any insect damage? Damage by wind or sleet, how much, etc? Do you need seed or seedlings, etc.?

REFERENCE
DO NOT CIRCULATE

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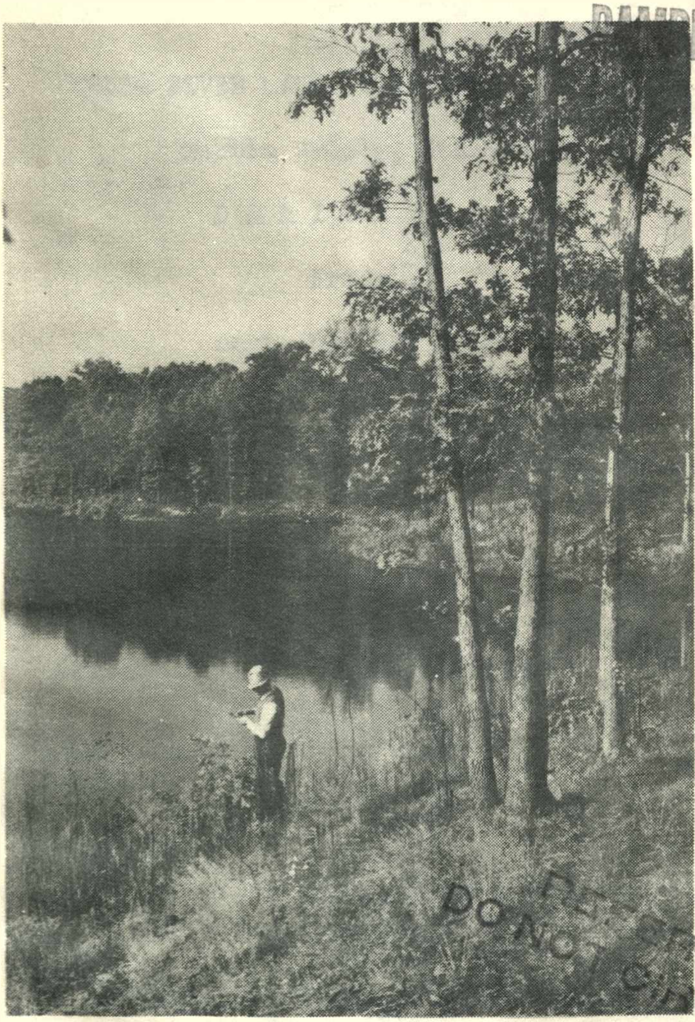
Ind - conservation of resources

WHITE RIVER
LAND UTILIZATION PROJECT
MARTIN COUNTY, INDIANA

PAMPHLET FILE



REFERENCE
DO NOT CIRCULATE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
INDIANA DEPARTMENT OF CONSERVATION
COOPERATING

WHITE RIVER LAND UTILIZATION PROJECT

Martin County, Indiana

DEDICATION

Friday,

September 15, 1939.

United States Department of Agriculture,
Soil Conservation Service
and
Indiana Department of Conservation
Cooperating

"It must be concluded that when land in a community becomes submarginal for farming it ceases to be a problem of individual concern. Individuals, because of their necessary short-time viewpoint, will exploit the last remaining resources before complete abandonment. In this process the entire community is affected by poverty, shrinking tax base, and mounting per capita costs of local government. These conditions of a community are soon reflected in turn to the county and state and must be considered problems for the people of the state to solve. Programs of legislative action and education directed toward bringing about reforestation and other better economic uses of land not adapted to farming seem warranted."

(Purdue University Bulletin No. 376)

Description of Project

The White River Land Utilization Project in Martin County lies within the Land Use Problem Region of Southern Indiana. This problem area embraces approximately a million and a quarter acres.

The present purchase area of the project includes approximately 32,000 acres. This land was acquired with federal funds under the administration of the United States Department of Agriculture. The Indiana Department of Conservation sponsored the project and cooperated in its development. One hundred and fifty families were affected by the purchase.

The project is devoted to forestry, wildlife and recreation. The development has been along these lines and has kept pace with acquisition of the submarginal lands.

Among the facilities that will be available to the public through the Indiana Department of Conservation, which will maintain and operate the project, is an 800-acre lake, created by a large earth-fill dam. This lake is being stocked with fish by the state, and will be available for fishing and boating.

Other developments include the planting of thousands of trees; woodland improvement over most of the forested area; construction of roads and hiking trails; construction of picnic grounds and shelter houses; construction of a caretaker's residence; planting of wildlife food and cover; development of wildlife refuges, and construction of a group camp.

The Story of The White River Project

Martin County was settled from 1815 to 1830, mostly by people from Virginia, the Carolinas, and Kentucky. By 1900 the maximum population was reached, and within 30 years the population had decreased by almost 50 percent, a decline that was due to depletion of timber resources which had supported a larger population at the beginning of the century.

Complete abandonment of a large proportion of the land took place between 1910 and 1930. After 1910 the population was of the transient type, moving out of the area as soon as the capital that had been brought in was exhausted. Because of economic conditions many of these poor-land farms were reoccupied during the early 1930's.

Martin County, then, presented a problem in land use. Human resources were being wasted in an attempt to farm land unsuited to agriculture -- land that had not supported a high type of agriculture even before soil erosion and loss of fertility entered the picture.

Living standards were low from the standpoint of housing comforts, educational and social opportunities, and dental, medical and dietary necessities. There were no sources of industrial employment. Because of lack of taxable wealth, roads were impassable in the fall, winter and spring. Schools were small, one-room buildings where the cost per pupil in many instances was double that of schools in adjoining communities. Tax delinquency was high. The relief load was heavy.

Nearly 90 percent of the money spent within the area each year for the necessary functions of local government represented taxes collected from other counties. For a decade 75 percent of the school costs was paid through state aid.

Recognizing the need for a concrete attack the United States Department of Agriculture, in cooperation with the State Conservation Department and Purdue University, planned the White River Land Utilization Project--a project designed to solve these problems by public purchase of the land. A strong County Planning Committee actively supported the program.

The land acquisition program was started in the Fall of 1934. A total of 32,000 acres of the poorest land in three townships of Martin County was purchased. Removal of this acreage from private ownership at the outset resulted in a $17,000 refund to the county in the form of delinquent taxes.

Approximately 150 families, who had been economic refugees on these submarginal lands, moved from the area. Analysis of the affected families showed that about 15 percent had sufficient equity to relocate on more productive lands; 20 percent, because of age or physical handicaps, were permanently dependent upon old-age pensions or relief; and the remaining 65 percent for the most part were workers able to support themselves when employment was available, and had resided in the area as squatters or because of low rent. Few of the people in this classification attempted to farm the land. Many were employed by the Works Progress Administration in the development of the project. The Farm Security Administration assisted many families in relocating outside the project area.

As many as 700 WPA workers were at times engaged in the development work. Forestry, control of soil erosion and protection of other natural resources constituted the major portion of the work program, but many items of construction were completed to carry out the land use objectives.

Erosion control was established by thousands of plantings of trees, shrubs and grasses, and check dams in gullies, by seeding of vegetation and sodding of slopes. Thirteen thousand acres of timber were culled and 4,000 acres were planted to young trees. Forest fire control was maintained over the project area and adjacent lands. More than 10 miles of fire lanes were built. Approximately 90 acres of picnic areas were developed. These areas include shelter houses, outdoor fireplaces, parking places, hiking trails, improved roadways.

Largest unit of construction was the dam in Furse Creek which created the 800-acre Greenwood Lake. The dam, which is 1,900 feet long and 55 feet high, was constructed on a 24-hour schedule during the summer months over a period of two years. Hundreds of spawning beds and fish shelters were constructed in the bed of the lake before flooding of the reservoir. Two fish rearing ponds of about an acre each were constructed near the dam to supply stock for the lake.

Wildlife development work included the construction of 140 small water holes; nearly a thousand upland game shelters; creation of a 3,500-acre game preserve; development of more than 300 game food and cover patches.

Because the area was designated by the state as headquarters for the District Forest Ranger of the Southwest District, a cabin, service and storage buildings were constructed for the ranger. A custodian's dwelling, service building and barn were also constructed.

A 300-man construction camp, built during the development of the project for use of workers, will be utilized by the State Conservation Department as an educational unit for meetings, training schools for wardens and foresters, and for sessions of conservation groups.

Eight miles of new road were built and 7 miles of old road were resurfaced. The road program required installation of 100 culverts and 6 bridges. Electric power was brought into the area by construction of 8 miles of line. Proper communication throughout the area was made possible by building of 27 miles of telephone line. Eight hundred and eleven abandoned buildings were razed and more than 300 miles of fence torn down. Three hundred wells were filled in for safety.

As a result of the land acquisition, 10 rural schools have been abandoned and, eventually, approximately 100 miles of roads can be closed. Economists point out that for every reduction of $1 in property tax incomes, local government expenses will be reduced $10.

The project, then, is of three-fold benefit. Families leave the submarginal area for better opportunities. Cost of local government is reduced greatly. In years to come the forests will again contribute to the wealth of the community.

ANNOUNCEMENTS

You are invited to enjoy the facilities of another Department of Agriculture Land Utilization Development in Brown County, near Nashville.

This project is devoted to forest, wildlife and recreation. The purchase area includes 20,000 acres of submarginal land. A 10-acre recreation area, complete with picnic tables and outdoor ovens and a shelter house, is available. A 120-acre lake has been stocked with fish and has attracted waterfowl. Two smaller lakes, where no development has been permitted, have been set aside for the benefit of wildlife. Two fish rearing ponds have been completed.

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Both the Brown County and White River Land Utilization Projects will be maintained and operated for the people of Indiana by the State Department of Conservation.

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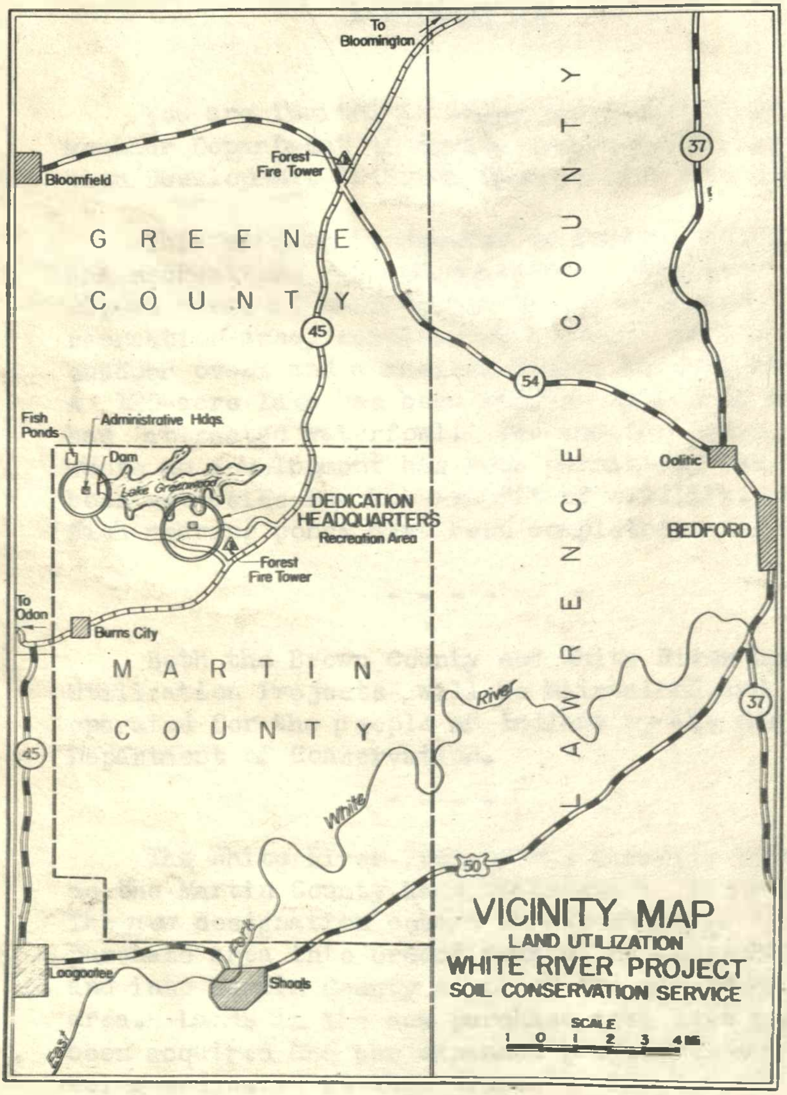
The White River Project was formerly known as the Martin County Land Utilization Project. The new designation covers an expansion of the purchase area into Greene County, on the north, and into Martin County south of the old project area. Lands in the new purchase area have not been acquired and the expanded project is not being dedicated at this time.



VICINITY MAP
LAND UTILIZATION
WHITE RIVER PROJECT
SOIL CONSERVATION SERVICE

REFERENCE
DO NOT CIRCULATE